



**Department of Natural Resources
Division of Reclamation - Restoration**

Submits

**Indiana Midwestern Abandoned Mine Land
Reclamation Project**

for the

**Year 2000 Abandoned Mine Land
Reclamation Awards**

by

AML Staff

Indiana Abandoned Mine Land Nomination for 2000

Name

MIDWESTERN ABANDONED MINE LAND RECLAMATION PROJECT
Site 1087

Location

The Midwestern Abandoned Mine Land Reclamation Project (site 1087) is located in the Illinois Coal Basin in the central portion of Pike County, Indiana, approximately 4 miles east of Arthur. The project is bounded by State Road 64 to the south, Midwestern Creek to the east and Pike State Forest to the north.

Submitting Organization

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Presented by

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Project start and completion dates

October 6, 1995 to October 31, 1997

Project costs

\$4,187,316.52

Responsible Agencies

Indiana Department of Natural Resources, Division of Reclamation
ATC Associates, Inc.
Foertsch Construction Company
Indianapolis Power and Light
Indiana Geological Survey
J.F. New and Associates

Date Submitted

March 2000

MIDWESTERN ABANDONED MINE LAND RECLAMATION PROJECT
PIKE COUNTY, INDIANA

The Midwestern Abandoned Mine Land Reclamation Project is located in the Illinois Coal Basin in the central portion of Pike County, Indiana, approximately 4 miles east of Arthur. The project is bounded by State Road 64 to the south, Midwestern Creek to the east and Pike State Forest to the north.

The site is positioned within a 6000 acre tract of land referred to as the Mill Creek Abandoned Mine Land Area and has significant value as a wildlife habitat. The 270 acre Midwestern Site was not eligible for funding through the AML Program until the 1991 amendment to SMCRA. Four mining companies mined coal at this site from August 1977 to November 1990. All these companies as well as their bonding companies subsequently went bankrupt leaving the areas in an unreclaimed state. Therefore, funding for this project not only consisted of regular AML funds, but also bond forfeiture funds and lost surety settlement funds for a total project cost of \$4,187,316.52.

ATC Associates Inc. (ATC) was retained by the Indiana Department of Natural Resources, Division of Reclamation (IDNR-DOR) to prepare design plans and specifications and provide construction support services for the Midwestern Site. J.F. New and Associates was retained by ATC to assist in the design of the wetland areas. Foertsch Construction Company was the successful low bidder and was retained by the IDNR-DOR to complete the reclamation project.

The intent of the Midwestern Reclamation Project was to improve site safety and reduce environmentally degrading conditions by backfilling or removing 4,400 linear feet of dangerous highwalls, to lessen the potential for acid mine drainage, to eliminate 30 million gallons of acid water in multiple impoundments, to dispose of derelict mining equipment and to reduce erosion by regrading and revegetating 250 acres of acidic spoils. Additionally, the project included the

construction of new wetlands and improvements to existing wetlands and ponds to enhance the wildlife habitats.

The main focus of this award application is the abandoned portable preparation plant area where site conditions included exposed coal refuse, unreclaimed minespoil, exposed highwalls, unreclaimed slurry ponds, areas of ponded water next to the exposed highwalls and within the minespoil, and acid seepage from abandoned underground mine workings. Photographs 1 through 3 in this application provide a general overview of the site before reclamation.

The initial reclamation plan for this area included the regrading of mine spoil, backfilling of the highwalls, and the consolidation and covering of exposed mine refuse. However, investigations of the areas within and immediately surrounding this site revealed a shortage of low-permeability cohesive soils for use in covering the coal refuse. It was determined that the quantity of borrow material needed to backfill the highwalls and to create the desired surface drainage conditions would disturb a large area of adjoining mine spoil that, although poorly graded, was heavily vegetated. The only locally available borrow that was not mine spoil was located within mature wooded areas that have significant wildlife value.

After reviewing the reclamation plan and limitations regarding locally available borrow materials, it was agreed that off-site borrow sources should be evaluated before proceeding with the project. After extensive investigations and research, it was determined that the use of coal combustion by-products (CCB) on this project would be beneficial in enhancing the quality of the water discharged from this site while providing a reliable borrow source. The CCB materials were supplied by Indianapolis Power and Light's (IPL) Petersburg Generating Station due to its close proximity to the Midwestern site. The use of these materials would limit the disturbance of adjoining wooded areas of both previously mined and undisturbed lands.

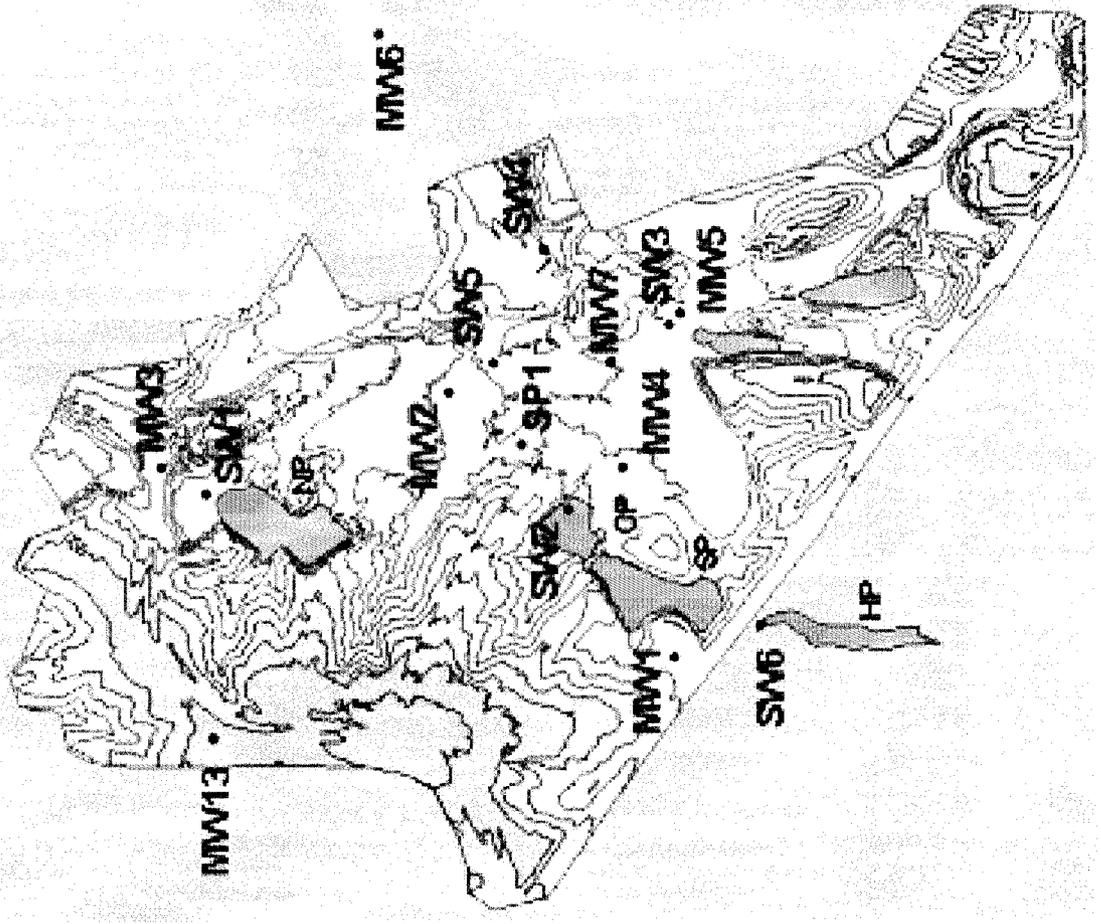
Since this project would be utilized to demonstrate the suitability of using CCB materials on future AML projects, it was agreed that it would be prudent to limit their use to one area. This would facilitate the monitoring of the long term impact on surface water and ground water quality. Therefore, the use of the CCB materials was limited to the area surrounding the abandoned portable preparation plant since all of the surface runoff and at least some of the ground water appear to flow toward a slow meandering wetland area of Midwestern Creek, a tributary to the Patoka River. Photographs 4 and 5 provide an overview of the project area during various stages of placement of the CCB materials.

In addition to the utilization of CCB materials, the reclamation techniques utilized on this project also included the construction of large anoxic limestone drains and wetland treatment areas as illustrated in Photographs 6 and 7. Although these measures have been implemented on a limited basis on other AML projects across the United States, they were still considered to be a relatively new innovation in reclamation in Indiana. The information gained by evaluating their effectiveness at this site further enhanced future application of this technology. Photograph 8 provides an overview of the project site following all reclamation activities.

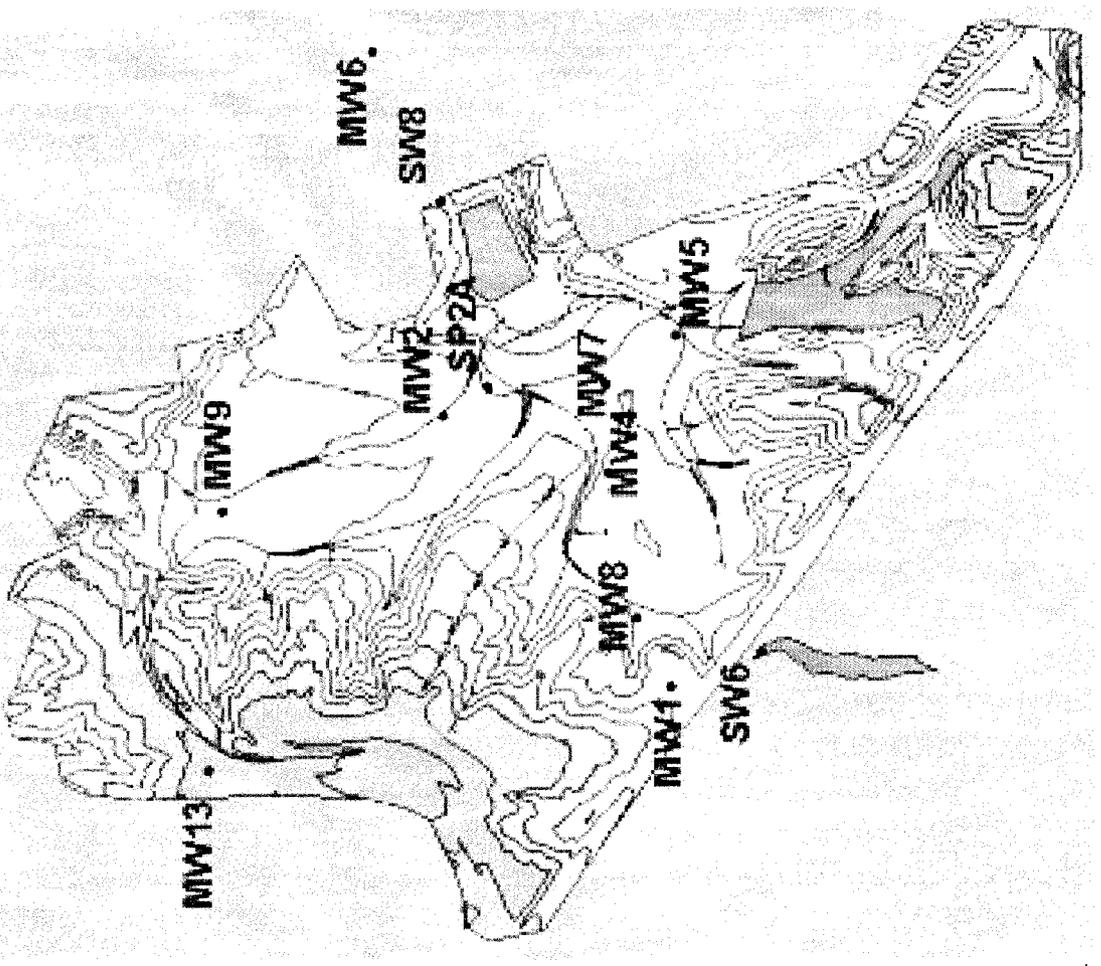
To document the effectiveness of reclamation at this site, the IDNR-DOR retained the Indiana Geological Survey (IGS) to monitor water quality both before and after construction. The purpose of their study was to evaluate the quality of ground and surface water in the vicinity of the site and determine the effectiveness of reclamation at improving the chemistry of water discharging from the site. Photograph 9 provides a view of one of the monitoring stations established by IGS. The following table presents the acid-mine drainage parameters on the Midwestern site and water quality at each monitoring station.

The relationships of pre- and post-reclamation monitoring sites to topography. Following graphs and tables from IGS Study.

Pre-reclamation
Water monitoring sites
began in April 1995



Post-reclamation
Water monitoring sites
ended in October 1998



Summary Table 1. Acid-Mine Drainage Parameters

Monitoring Site	N	pH	TDS (mg/L)	Acidity (mg/L CaCO ₃ equiv)	Alkalinity (mg/L CaCO ₃ equiv)	Total Iron (mg/L)	Manganese (mg/L)
MINE AQUIFER							
MW1 (Pre)	8	5.9 - 6.5	1000 - 1700	0 - 180	70 - 210	3 - 26	5.0 - 12
(Post)	9	6.1 - 7.1	1000 - 1800	27 - 91	120 - 190	4 - 12	5.5 - 9.0
MW13 (Pre)	7	6.1 - 6.7	490 - 990	6 - 23	260 - 490	3 - 11	0.2 - 2.5
(Post)	9	6.4 - 7.3	660 - 1000	2 - 15	420 - 480	1 - 7	0.2 - 2.4
WATER-TABLE AQUIFER							
MW2D (Pre)	3	6.4 - 6.8	2800 - 3000	0 - 29	360 - 560	13 - 22	0.6 - 1.0
(Post)	9	6.2 - 7.0	3200 - 3800	75 - 150	580 - 680	40 - 50	1.0 - 2.6
MW4D (Pre)	4	4.1 - 5.2	2700 - 4700	350 - 740	0 - 34	120 - 240	7.4 - 13
(Post)	8	5.7 - 6.8	3900 - 5100	140 - 320	140 - 250	19 - 99	38 - 46
MW5 (Pre)	4	3.0 - 3.4	3700 - 4700	140 - 860	0	250 - 320	17 - 20
MW5S (Post)	8	5.5 - 6.8	4400 - 9100	110 - 1800	68 - 330	46 - 410	7 - 110
"M (Post)	9	3.4 - 4.5	4700 - 10000	1000 - 4600	0	420 - 1400	31 - 93
"D (Post)	8	3.8 - 4.4	4700 - 6800	960 - 2400	0	410 - 880	34 - 70
MW6 (Pre)	8	5.2 - 5.9	310 - 1700	40 - 360	14 - 39	30 - 175	6.6 - 37
(Post)	8	5.1 - 5.8	230 - 1500	43 - 320	0 - 35	18 - 120	4.2 - 28
MW7D (Pre)	3	1.1 - 1.8	12000 - 35000	2100 - 12000	0	2800 - 5700	9.0 - 24
(Post)	9	1.6 - 3.1	11000 - 29000	3000 - 13700	0	1500 - 5700	11 - 18
SURFACE WATERS							
SP1 (Pre)	3	3.7 - 5.1	1900 - 2100	180 - 720	0 - 34	65 - 81	0.2 - 8.0
SP2 (Interim)	4	5.3 - 5.7	2000 - 2200	180 - 220	15 - 67	71 - 110	8.0 - 9.0
SP2A (Post)	10	6.5 - 7.3	2200 - 2900	110 - 260	230 - 290	70 - 120	6.6 - 15
SW4 (Pre)	4	2.8 - 3.1	3300 - 3900	280 - 840	0	190 - 330	14 - 25
SW8 (Interim)	4	3.1 - 7.0	2150 - 2300	23 - 370	0 - 125	5 - 100	8.3 - 12
SW8 (Post)	9	3.0 - 7.0	1700 - 3600	52 - 350	0 - 140	15 - 83	6.5 - 19

The following excerpt from the IGS Study gives a clear picture of the excellent results attained as of October 1998.

"Summary of Results: Prior to reclamation, acidic mine drainage (AMD) was being derived from contaminant plume in the central refuse area and from a spring that discharged from abandoned underground mines. This problem drainage was addressed by a combination of the following techniques: (1) fixated scrubber sludge (FSS) was placed over the refuse deposit to prevent vertical recharge of the shallow water table, (2) surface-mine highwall-pits were filled and capped, (3) a Passive Anoxic Limestone Drain (PALD) was installed to treat a spring that discharges from the underground workings, and (4) final treatment of surface waters was accomplished through a series of wetland cells and settling ponds.

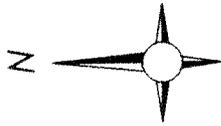
A comparison of data collected before and after reclamation indicates that total acidic outfall from the site during the critical period of April through October (which is the season when AMD is typically most concentrated) has experienced a five-fold reduction. This reduction represents a net gain of about 2×10^5 kilograms of alkalinity (CaCO_3 equivalent) in the acid-base balance of the site. This was accompanied by a five-fold reduction in the concentrations of iron and aluminum. Among trace elements, the concentrations of boron, molybdenum, selenium, copper and chromium increased for a brief period either during reclamation or shortly after, but have since decreased. Nickel and cadmium concentrations continue to show fluctuations corresponding to pH shifts but at lower concentrations than before reclamation. Lead and mercury concentrations have decreased to detection limits since reclamation. Antimony and silver have not been detected at all. Chloride and potassium concentrations have increased only slightly.

Hydrologic monitoring and geophysical investigations indicate that the pre-existing contaminant plume within the refuse is being effectively isolated from vertical recharge by the FSS. Also, the proportion of rainfall that leaves the site as direct runoff has increased. This increased storm runoff has not caused any erosion on the site, and sufficient moisture is being retained in the soil cover to insure healthy vegetation.

Continuous monitoring of water quality at the outlet indicates that the storm runoff is much more dilute than baseflow. Also, simultaneous monitoring of discharge at the site's outlet and at the outlet of the PALD is effectively treating the mine water, so that even the baseflow is more dilute and less acidic than it was prior to reclamation.

The results of our investigation show that this reclamation approach has favorably altered the hydrologic and hydrochemical conditions on the site in such a way that rain water has a shorter residence time and is less exposed to acid-generating conditions. This has been achieved without any significant leaching of detrimental trace elements from CCB's."

PHOTO LOCATION MAP
MIDWESTERN ABANDONED MINE
LAND RECLAMATION PROJECT
PIKE COUNTY, INDIANA



LEGEND:

① ——— INDICATES LOCATION AND DIRECTION OF PHOTOGRAPHS

