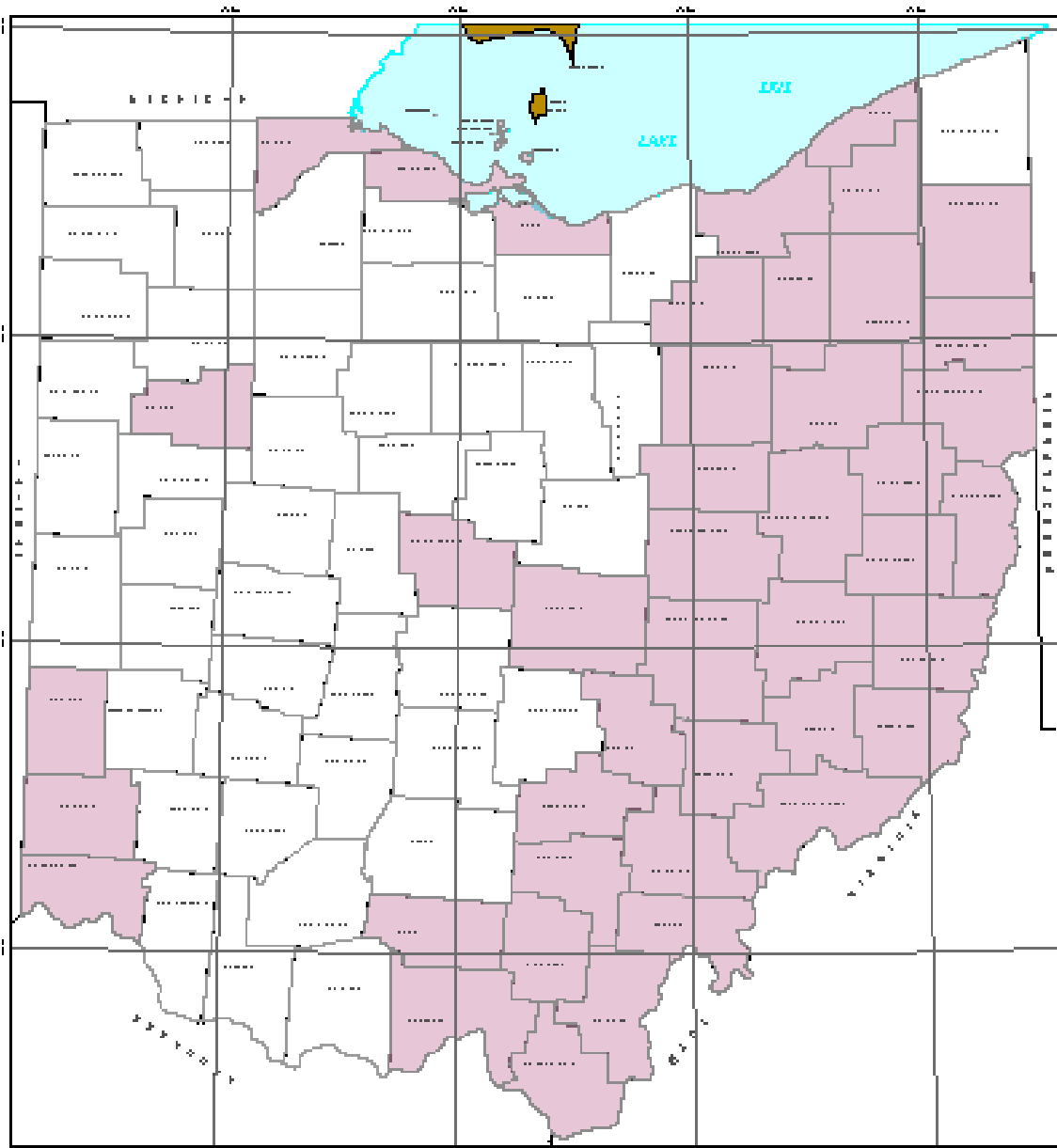


Utilizing GIS to Maintain and Manage Mine Maps and Mine Map Database

**Joseph Wells, Charles Banks, & Larry Wickstrom
Energy Resources Group
Ohio Division of Geological Survey**



State of Ohio Counties with known AUM's



NO. OF CO. WITH KNOWN AUM'S

0

1

2

3

Explanation



N

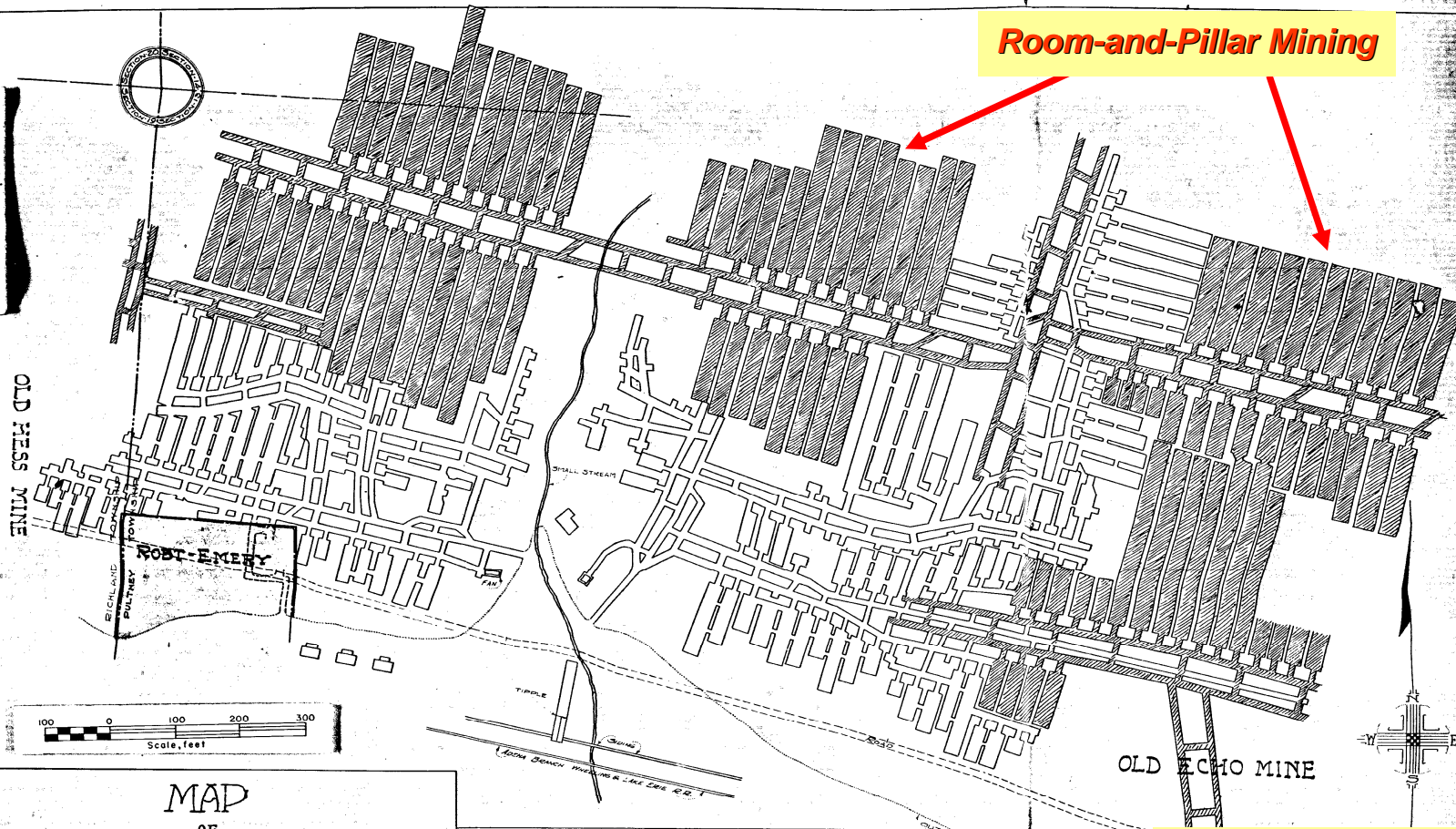


43 Counties
with AUM's



Scanned Image of Abandoned Underground Detailed Mine Map

Room-and-Pillar Mining



MAP
OF
ABANDONED MINE No. 7
THE MAHER COLLIERIES CO

LOCATED IN
SECTION 13 TOWNSHIP 6 RANGE 3
PULTRNEY TOWNSHIP BELMONT COUNTY, O.
SCALE 1"=100'

CERTIFICATE OF ENGINEER

I THE UNDERSIGNED HEREBY CERTIFY THAT THE ABOVE MAP IS TRUE AND CORRECT AND SHOWS ALL THE INFORMATION REQUIRED BY SECTION 937 OF THE GENERAL CODE AND COVERS THE EXCAVATIONS TO THE DATE OF ABANDONMENT ON APRIL 1-1922.

SIGNED
W. H. HARTLAND, ENGINEER.

ACKNOWLEDGED BEFORE ME A NOTARY PUBLIC THIS 22... DAY OF ... 1922.

SIGNED
Eugene W. Hartland, NOTARY PUBLIC.

NOTE - ALL WORKINGS OF OLD MINES IS SHOWN CROSSHATCHED.

Scanning of Images
Provided by
The Office of Surface
Mining (OSM)

OGS 03041 204 16X 314855

Abandoned Mine BT-005, Pultney Township, Belmont County, Ohio

Mine Entry

Mine Polygon

Superimposed Mine Polygons

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plotted on
eological
pographic



ANNUAL MINE MAP DATA SHEET

OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Geological Survey

ANNUAL MINE MAP DATA SHEET

Mine Name: _____

Operating Company: _____

County: Muskingum _____

Land Survey: _____

Quadrangle: _____

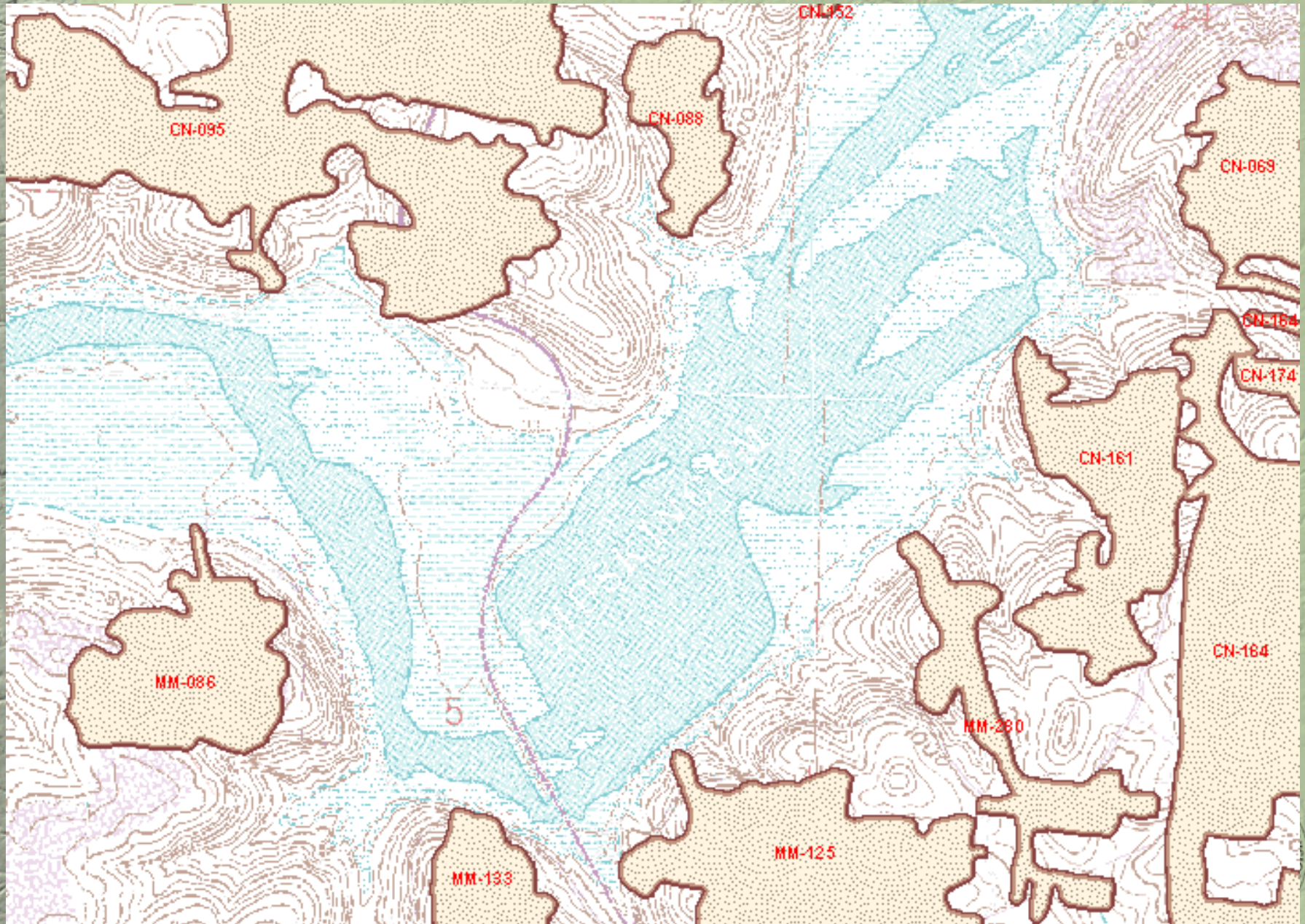
- No annual mine map
Annual Mine Map date(s)
 Ann. map date ranges from _____ to _____

- Drift opening
- Slope opening
- Shaft opening
- Hoisting shaft is _____ feet deep
- Elevation _____ feet at drift mouth
- Elevation _____ feet at top of shaft/slope
- Elevation _____ feet at base of shaft/slope
- Several elevations are shown
- Elevation _____ feet at top of air shaft
- Elevation _____ feet at base of air shaft
- Coal thickness _____
- Coal thickness ranges from _____ to _____
- Location of company building(s) is shown
- Location of company building(s) is shown including mule barn or stable
- Location of company home(s) is shown
- Location of underground stable is shown
- Location of drill hole(s) is shown
- Location of drill hole(s) including coal depth and/or coal thickness is/are shown
- Location of oil/gas well(s) is shown
- Area(s) marked "abandoned," "old works," "worked out," "inaccessible" is/are shown
- Area(s) marked "caved," "fallen-in," "roof fall," "bad roof," "bad top," "faulty" is/are shown
- Area(s) marked "holed into old works" is/are shown
- Area(s) marked "squeeze," "squeezed shut" is/are shown
- Area(s) marked "pillars drawn," "pillars out," "pillar work," is/are shown
- Area(s) marked "water," "full of water," "flooded," is/are shown
- Area(s) marked "fault," "horse-back," "cut-out," is/are shown
- Location of longwall panel(s) is shown
- Openings to unmapped mine are shown
- Shows works to: _____
and _____
and _____
- Other

Get example of
another data sheet.
One for points too.



Digitized Mine Polygons



AND TO FROM ANNUAL MINE MAP DATA SHEET Database Entry and Retrieval Form

OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Geological Survey

Microsoft Access - [frmMineOpening : Form]
File Edit View Insert Format Records Tools Window Help

Abandoned Underground Mine Map Openings

Mine Opening ID:

Opening Type: Source: Date of Rec:

County: Township:

Commodity: Quadrangle:

Operator: Mine Name:

Seam Name: Elev: ft. Thickness: in.

Comment(s):

DATA SHEETS TO DATABASES



Find Record Add New Quit

Record: 1 of 2144

Form View NUM 3:32 PM

Ohio Geological Survey Use of Modified API Primary Key

12345678901234 – the standard is a 14-digit system broken down as:

12-345-6-7890-12-34

Where:

12 = state code, Ohio = 34 (see attached list of all other states)

345 = county code (see attached list for all counties)

6 – data type-indicator (8 = Coal collection)

7-10 – permit number or individual feature ID

**11-12 – sidetrack number used for O&G wells; subcategory indicator
when needed in other collections**

**13-14 – multi-completion number used for O&G wells; used
as qualifier for other data types**



Ohio Geological Survey Use of Modified API Primary Key

Coal and Underground Mine data

12-345-6-7890-12-34

Where:

6 – data type-indicator (8 = Coal data collection)

7-10 – individual feature ID

11-12 51 – Coal-core and strat holes – NCRDS

52 – AUM data

13-14

01 – mine poly

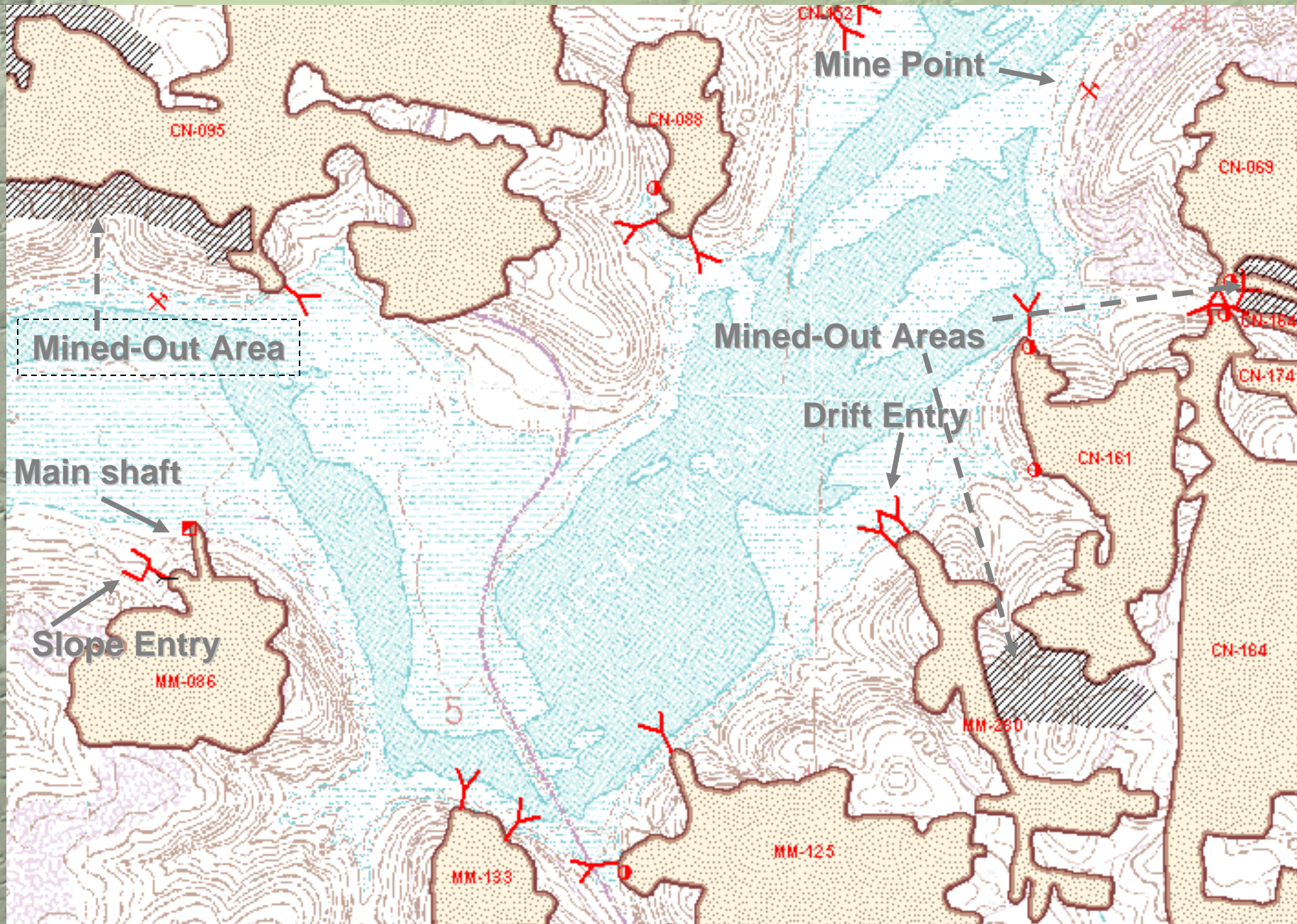
02 – mine points

03 – hachured poly

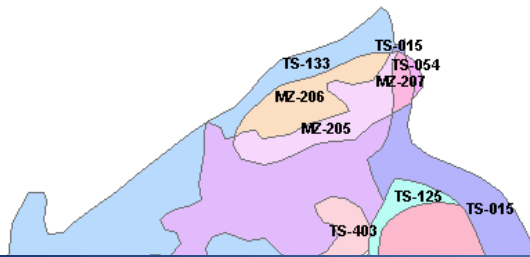
**Example: 340138001235201 = An AUM poly (ID=00123)
in Belmont Co, Ohio**



Digitized Mine Polygons, Points, Openings, and Mined-Out Areas



Issues with Overlapping Mines and Multi-polygon Mines



Attributes of Mine_temp_new

FID	Shape*	OBJECTID	MINE_CODE	MULT	MC_2	MC_3	MC_4	DRAIN	Shape_Leng	Shape_Area	MINE_API
0	Polygon	5318	TS-113	1				A	10307.528009	2734091.09605	341578011302
1	Polygon	5320	TS-133	1				A	16754.692306	4735654.50535	341578013302
2	Polygon	5321	TS-403	2	TS-113	TS-403		A	13528.463440	2708229.90325	341578040302
3	Polygon	5322	TS-015	1				A	5737.191397	906893.86735	341578001502
4	Polygon	5323	TS-015	1				A	835.660227	29214.36755	341578001502
5	Polygon	5324	TS-039	1				A	3178.682121	502278.0266	341578003902
6	Polygon	5325	TS-125	1				B	4118.097432	844539.4124	341578012502
7	Polygon	5326	TS-401	2	TS-401	TS-062		A	11685.311356	1929930.00625	341578040102
8	Polygon	5327	TS-062	1				A	14696.417275	4365297.09005	341578006202
9	Polygon	5419	TS-054	2	TS-403	TS-054		A	2201.343978	261912.0351	341578005402

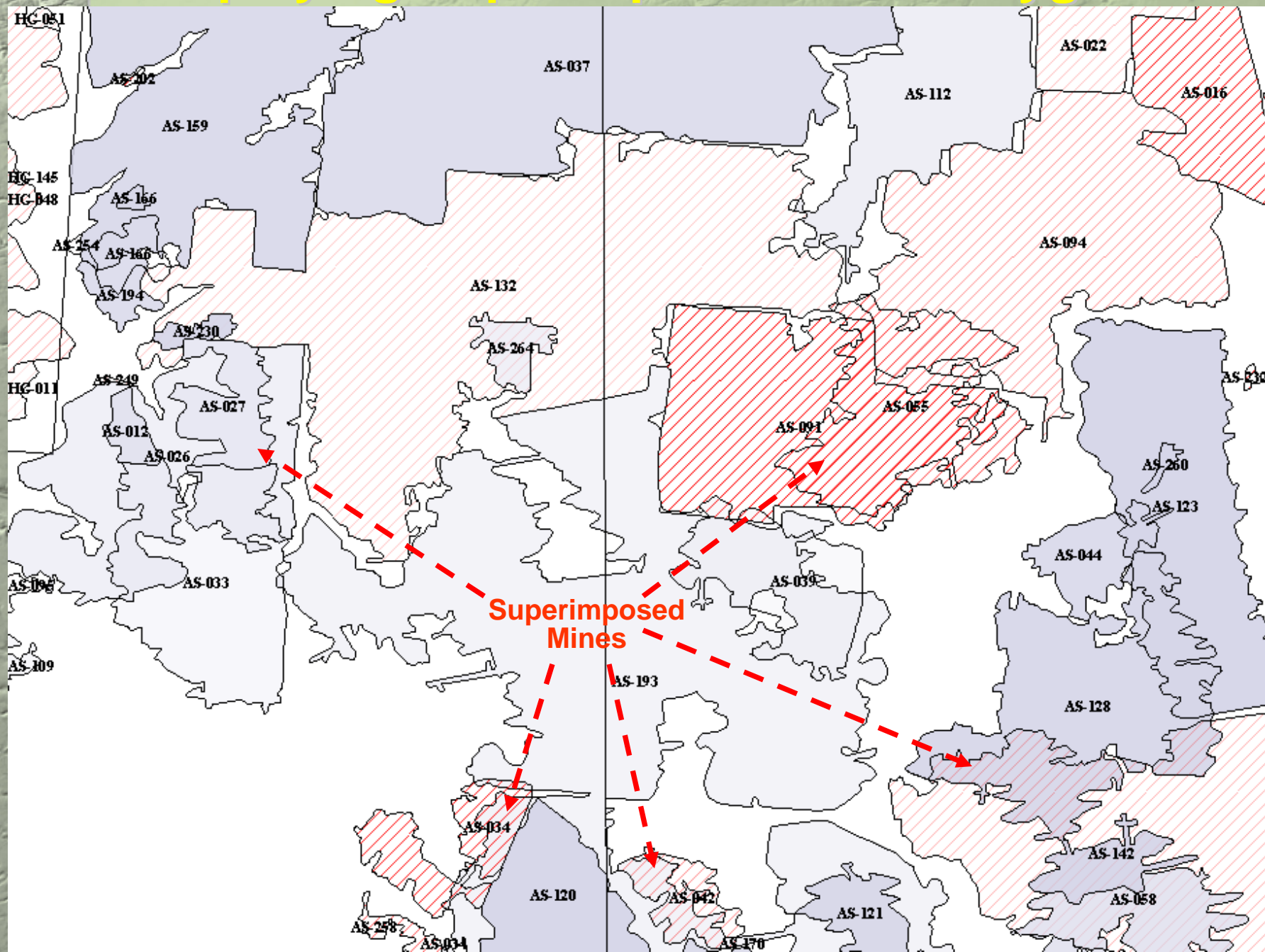
Overlapping Mines

Record: 1 Show: All Selected Records (0 out of 10 Selected.)

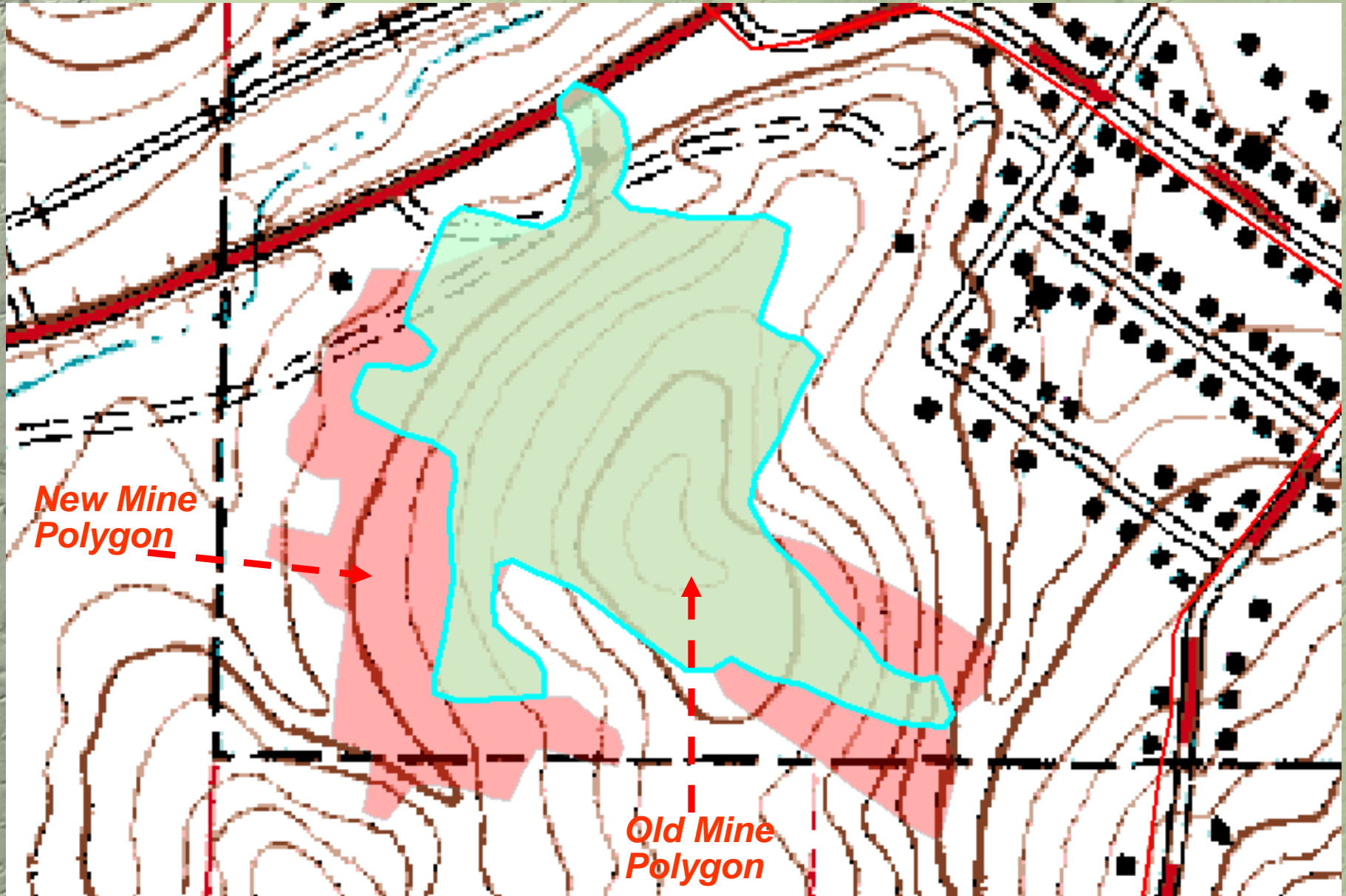
Start | Inbox - ... | BBC Wo... | WebMail... | Georef... | ArcCatal... | Microsof... | DIGITL... | 2:20 PM



Displaying Superimposed Mine Polygons

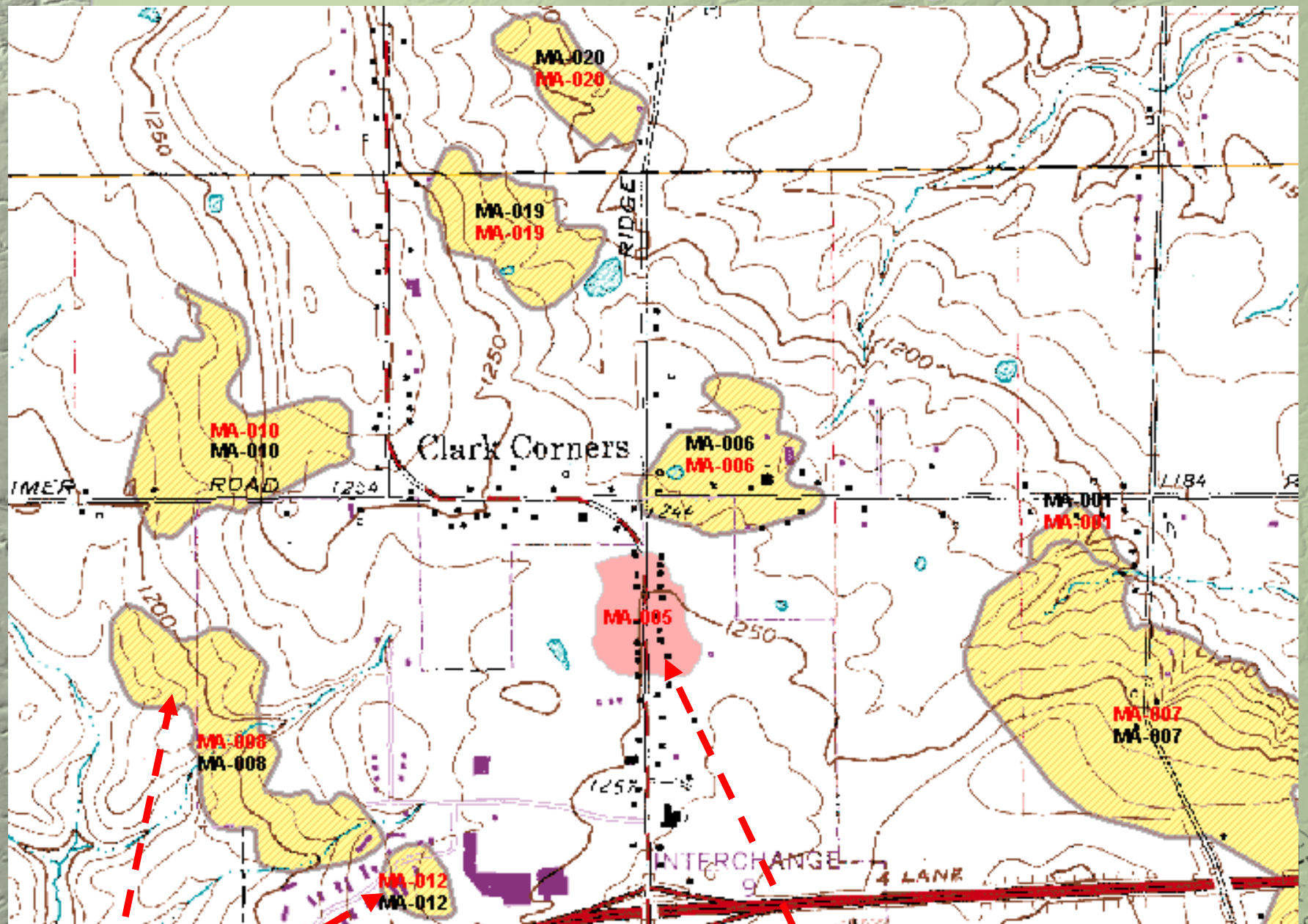


Re-Digitizing Mine Polygons



HN-002, Bowerston Quadrangle, Ohio

Addition of Mine Polygons



Original Mine Polygons

Added Mine Polygon

**The New
AUM Feature Classes,
Geodatabase,
and
Data Storage**



AUM Points Symbology and Feature Class Attribute Table

The screenshot displays the ArcMap interface with the 'Attributes of AUM_PTS' table open. The table contains the following data:

OBJECTID*	Shape*	MN_NO	ENTRY_CD	TYPE_CDE	MINE_API*	PNT_API*	ANGLE
917	Point	CL-041	DR	DR	<Null>	34019802040	355
1230	Point	MG-044	SL	SL	<Null>	34099800850	355
3890	Point	GY-080	DR	DR	<Null>	34059801110	355
4587	Point	GY-002	DR	DR	<Null>	34059802190	355
4653	Point	BT-139	DR	DR	<Null>	34013811160	355
4670	Point	BT-267	SL	SL	<Null>	34013809200	355
7300	Point	AS-133	DR	DR	<Null>	34009801050	355
7314	Point	WN-004	DR	DR	<Null>	34167800090	355
8420	Point	MS-104	DR	DR	<Null>	34105805670	355
8425	Point	MS-104	DR	DR	<Null>	34105805870	355
8426	Point	MS-104	DR	DR	<Null>	34105805880	355
8435	Point	MS-028	SL	SL	<Null>	34105803470	355
8440	Point	MS-014	DR	DR	<Null>	34105803410	355
8532	Point		DR	DR	<Null>	34053803050	355
8603	Point	GA-050	DR	DR	<Null>	34053801350	355
9222	Point	LE-004	DR	DR	<Null>	34087804900	355
9343	Point	HS-035	DR	DR	<Null>	34157812180	355
9362	Point	HN-084	DR	DR	<Null>	34067803390	355
9388	Point	GY-145	SL	SL	<Null>	34059803490	355
17046	Point	MS-001	DR	DR	34105800010	34105806320	355
25	Point	SK-189	DR	DR	<Null>	34151805250	353
30	Point	SK-021	DR	DR	<Null>	34151805170	350
911	Point		DR	DR	<Null>	34019802270	350
3880	Point	GY-074	DR	DR	<Null>	34059801010	350
8419	Point	MS-104	DR	DR	<Null>	34105805810	350
8421	Point	MS-104	DR	DR	<Null>	34105805830	350
8665	Point	MS-039	DR	DR	<Null>	34105803500	350
8730	Point	MS-006	SL	SL	<Null>	34105803350	350
9351	Point	HN-084	DR	DR	<Null>	34067804180	350
9352	Point	HN-084	DR	DR	<Null>	34067804190	350

The TOC on the left shows the 'AUM_PTS' layer selected, with symbology for 'Air Shaft or Pumping Shaft' highlighted in a red box. A red arrow points from this box to the text 'Adopted Mine Color'.

Adopted Mine Color

MINISION

The New AUM Personal Geodatabase

ArcCatalog - ArcInfo - G:\AUM\AUM.mdb

File Edit View Go Tools Help

Location: G:\AUM\AUM.mdb

Contents Preview Metadata

Name	Type
ANNOTATION	Personal Geodatabase Feature Data...
lines	Personal Geodatabase Feature Data...
Points	Personal Geodatabase Feature Data...
Polygons	Personal Geodatabase Feature Data...
Shields	Personal Geodatabase Feature Data...
AUM_HACHURED	Personal Geodatabase Feature Class
AUM_MINES	Personal Geodatabase Feature Class
aum_out	Personal Geodatabase Table
AUM_PTS	Personal Geodatabase Feature Class
btcontours	Personal Geodatabase Feature Class
BTPOINTS	Personal Geodatabase Feature Class
county_83_v2	Personal Geodatabase Feature Class
entry_line	Personal Geodatabase Feature Class
MN_POINTS	Personal Geodatabase Feature Class
OSM DocNum	Personal Geodatabase Table
quad24k_83	Personal Geodatabase Feature Class
RTE_LOCAL	Personal Geodatabase Feature Class
RTE_MUNI	Personal Geodatabase Feature Class
RTE_STATE	Personal Geodatabase Feature Class
STR_CONTOURS	Personal Geodatabase Feature Class
STR_POINTS	Personal Geodatabase Feature Class
tblComments	Personal Geodatabase Table
tblCommodity	Personal Geodatabase Table
tblCounty	Personal Geodatabase Table
tblMineOpenings	Personal Geodatabase Table
TBLMINES	Personal Geodatabase Table
TBLMINES1	Personal Geodatabase Table
tblOperator	Personal Geodatabase Table
tblQuad	Personal Geodatabase Table
tblRemainingImages	Personal Geodatabase Table
tblSeam	Personal Geodatabase Table
tblTownship	Personal Geodatabase Table
tblTwp	Personal Geodatabase Table
tblTownship	Personal Geodatabase Table

Coverages
Shapefiles

Raster Dataset
and
dBase Tables

A Single Data Repository !!!

The AUM Maps

1: 24000

cales

ent

ad

1: 62,500

ad

Portrait

de" County

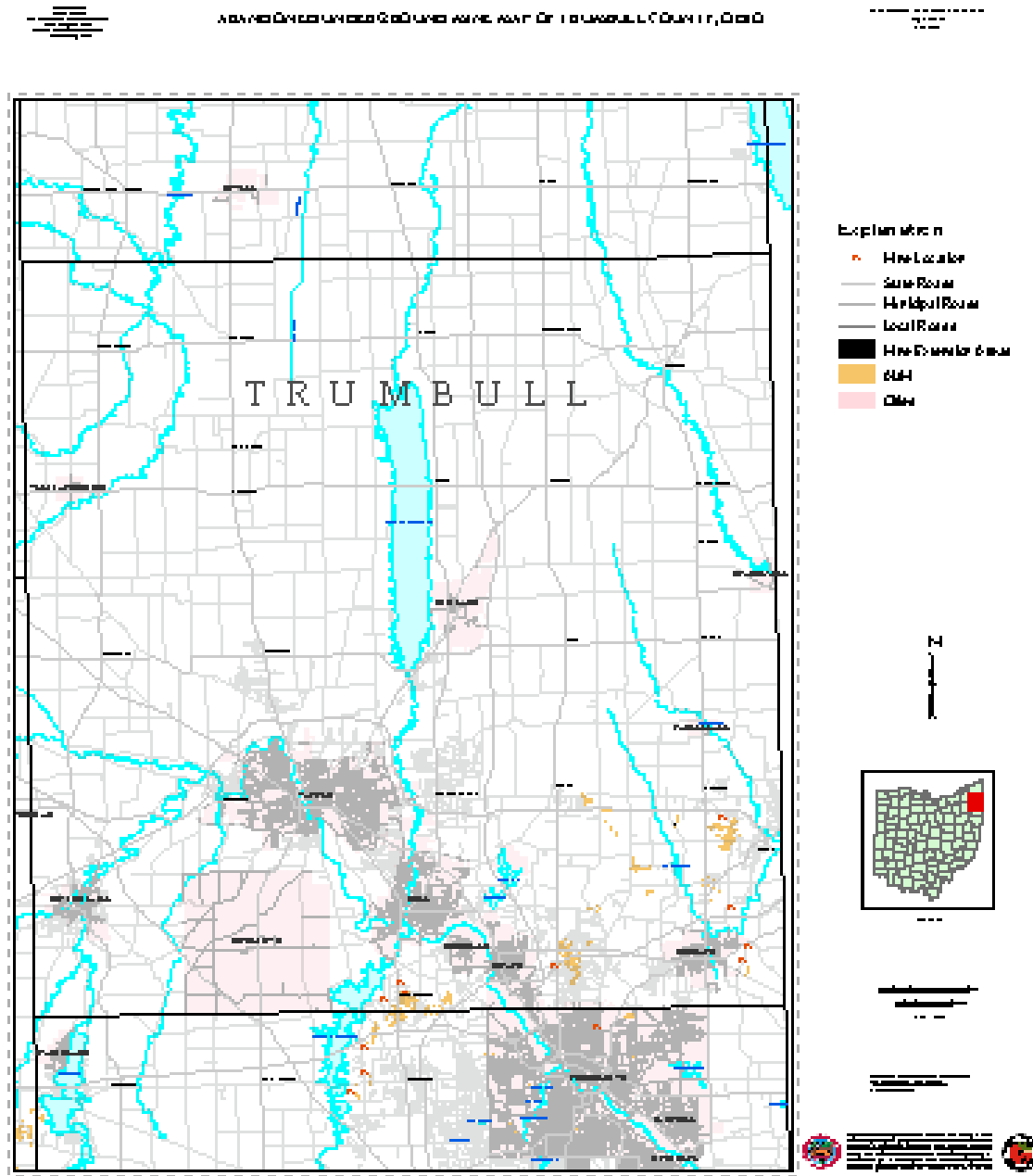
and

ll" County

Landscape

ional (quarters of state)

tewide



AUM Statistics

- Number of mapped AUM Polygons = 4,327
- Mined-Out Areas = 889
- Mine Point Locations = 1,945
- Air/Pumping Shaft entry points = 2,878
- Main Shaft entry points = 585
- Drift entry points = 9,475
- Slope entry points = 564
- Geo-referenced mine maps (mosaics) = 2,644
- Number of known underground mines = 7,120
(based on mapped AUM's and mine points)



Future Work

- **AUM Geodatabase:** Migration from that of a personal geodatabase to that of a multi-user geodatabase in ArcSDE running on a SQL Server DBMS.
- **Continued Multi-agency Cooperative projects:**
 - Field mapping and data collection (GPS data) of mine subsidence-incidence information. Predictive modeling.
 - Geo-referencing and rectification of all AUM map images (TIFF images). Make readily available to all.
 - Continue efforts to collect information on all mines – mapped or unknown.
- **Upgrade quality of data on known mines.**
 - Associate NCRDS points with mines. Additional control from O&G wells.
 - Use coal maps to augment mine info.
- **Keep interactive website relevant and up-to-date.**





tblLocational

NCRDS AND COAL AVAILABILITY

QA / QC

Process date: 1/1/1990

POINT_ID: D0004-12

QUAD and SERIES: MC ARTHUR (7.5') SURFACE ELEV: 990

STATE: OHIO ELVPREC: [dropdown]

COUNTY: VINTON DESCRIPTION LOG: DRILL HOLE [dropdown]

PROVINCE: EASTERN WEATHERING: FRESH [dropdown]

REGION: APPALACHIAN OWNER: OHGS

FIELD: 0 CONFID: N

GEOLOGIST: OHGS-AXON A G SEC - LOT: 16

SOURCE: ODNR-DIV OF RECLAMA COMMENT: CLINTON TWP

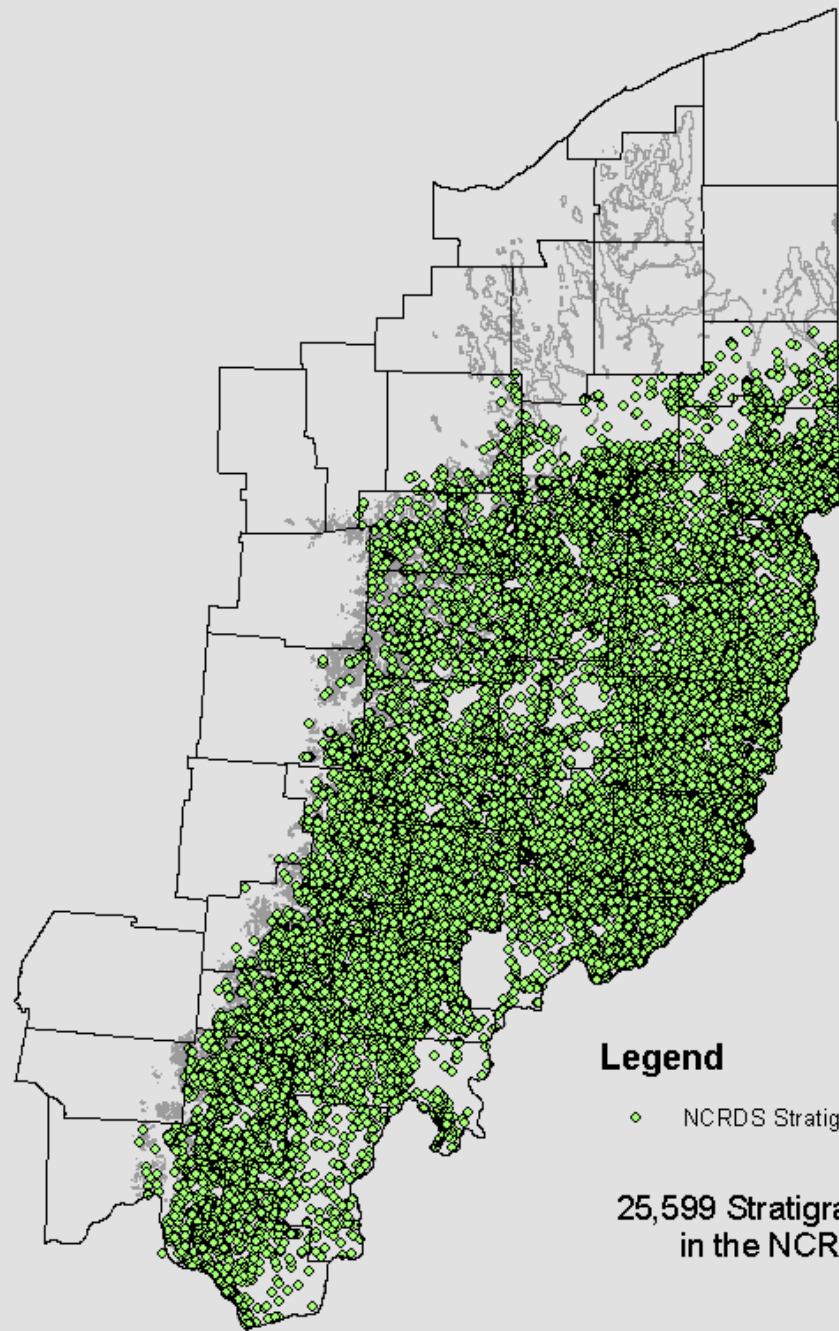
Stratigraphy: TOWNSHIP: CLINTON

	Unit	Unit Qualifier	Thickness	Formation	Bed	Primary Lithology	Lith
▶	01		2.33	ALLEGHENY G		NR	
	02		39	ALLEGHENY G		SS	
	03	EA	2.58	ALLEGHENY G	MDL KITTANNING	COAL	
	04		2	ALLEGHENY G		FCLY	
	05		24	ALLEGHENY G		SH	
	06	EA	2.33	ALLEGHENY G	LOWER KITTANNIN	COAL	
	07		2	ALLEGHENY G		FCLY	
	08		34	ALLEGHENY G		SH	

jw

Record: 8 of 25600





Legend

◆ NCRDS Stratigraphic Points

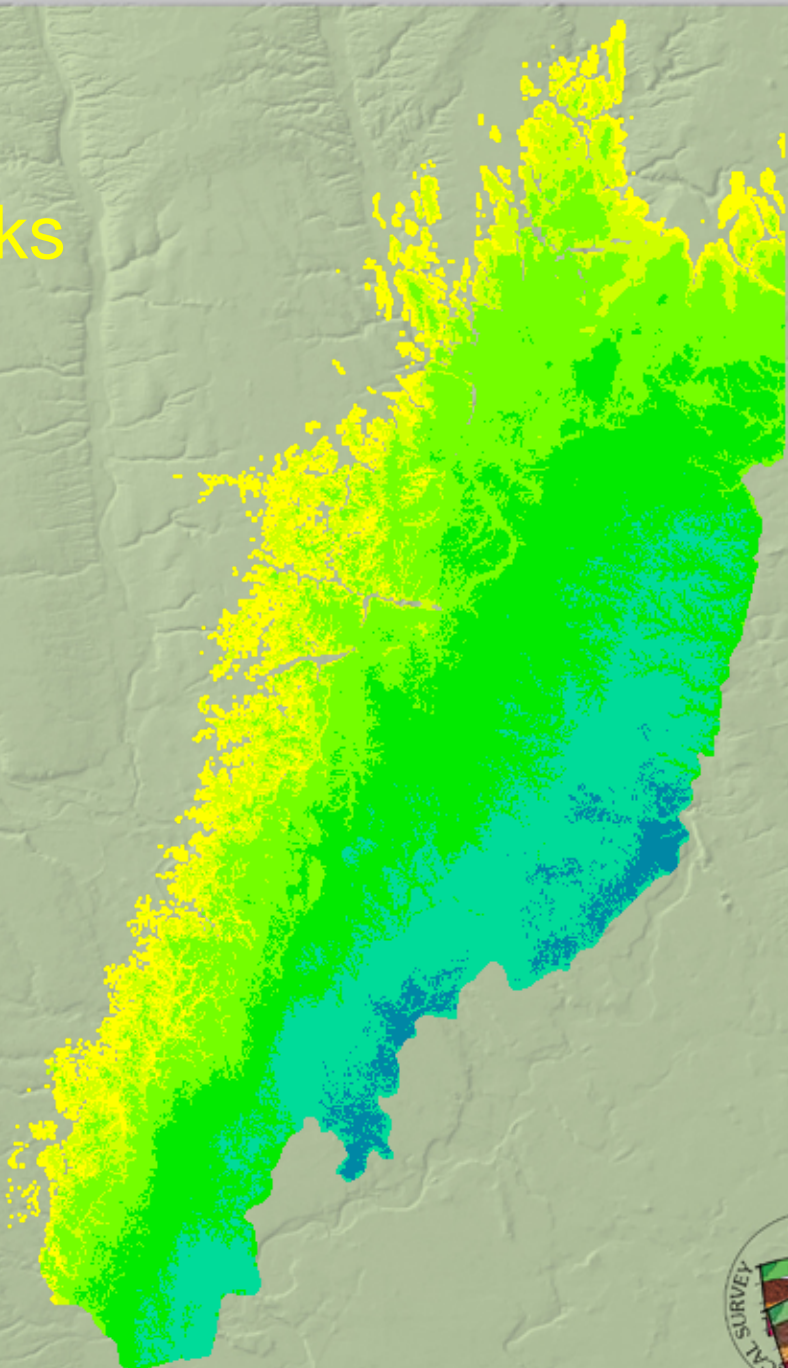
**25,599 Stratigraphic Descriptions
in the NCRDS Database**

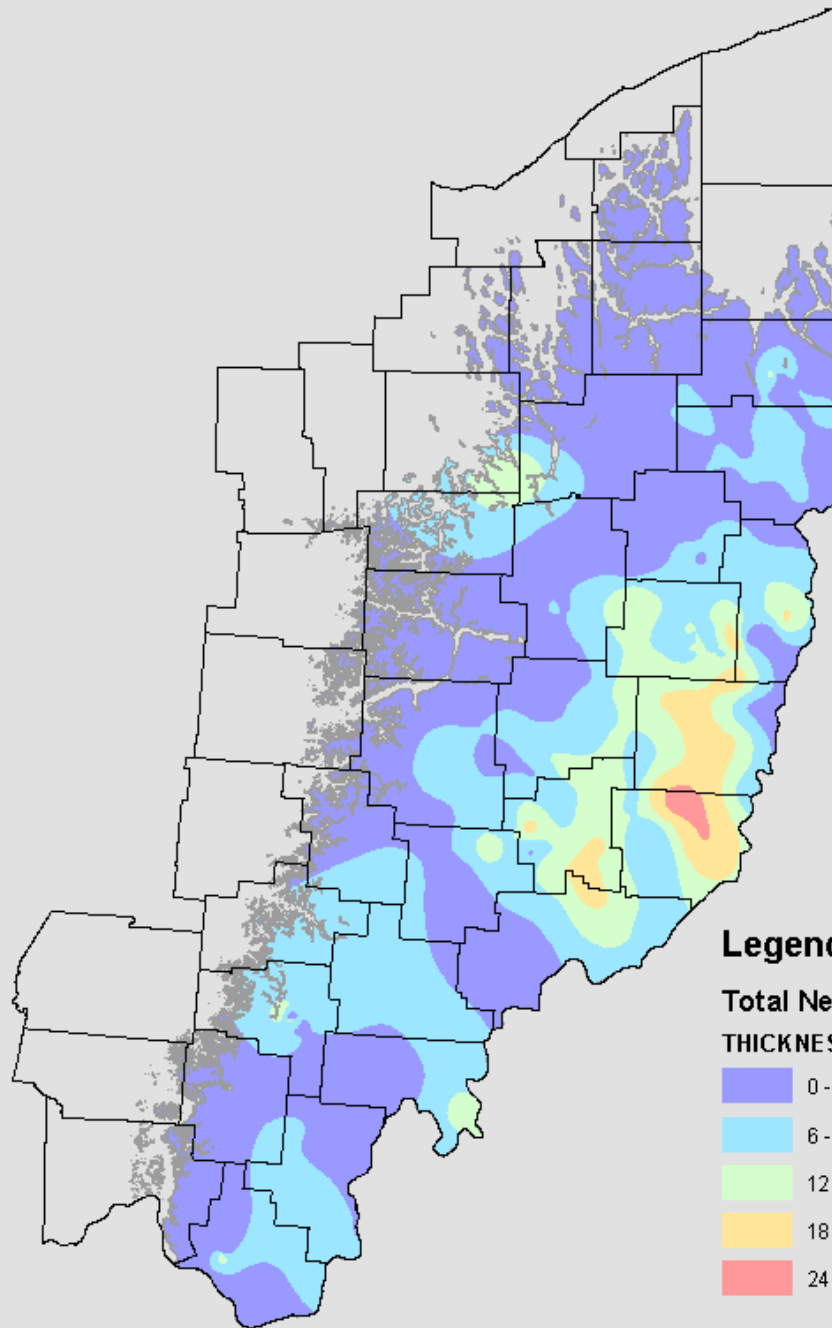


Depth of coal bearing rocks



In feet





Legend

**Total Net Coal
THICKNESS**

-  0 - 6 feet
-  6 - 12 feet
-  12 - 18 feet
-  18 - 24 feet
-  24 - 27 feet



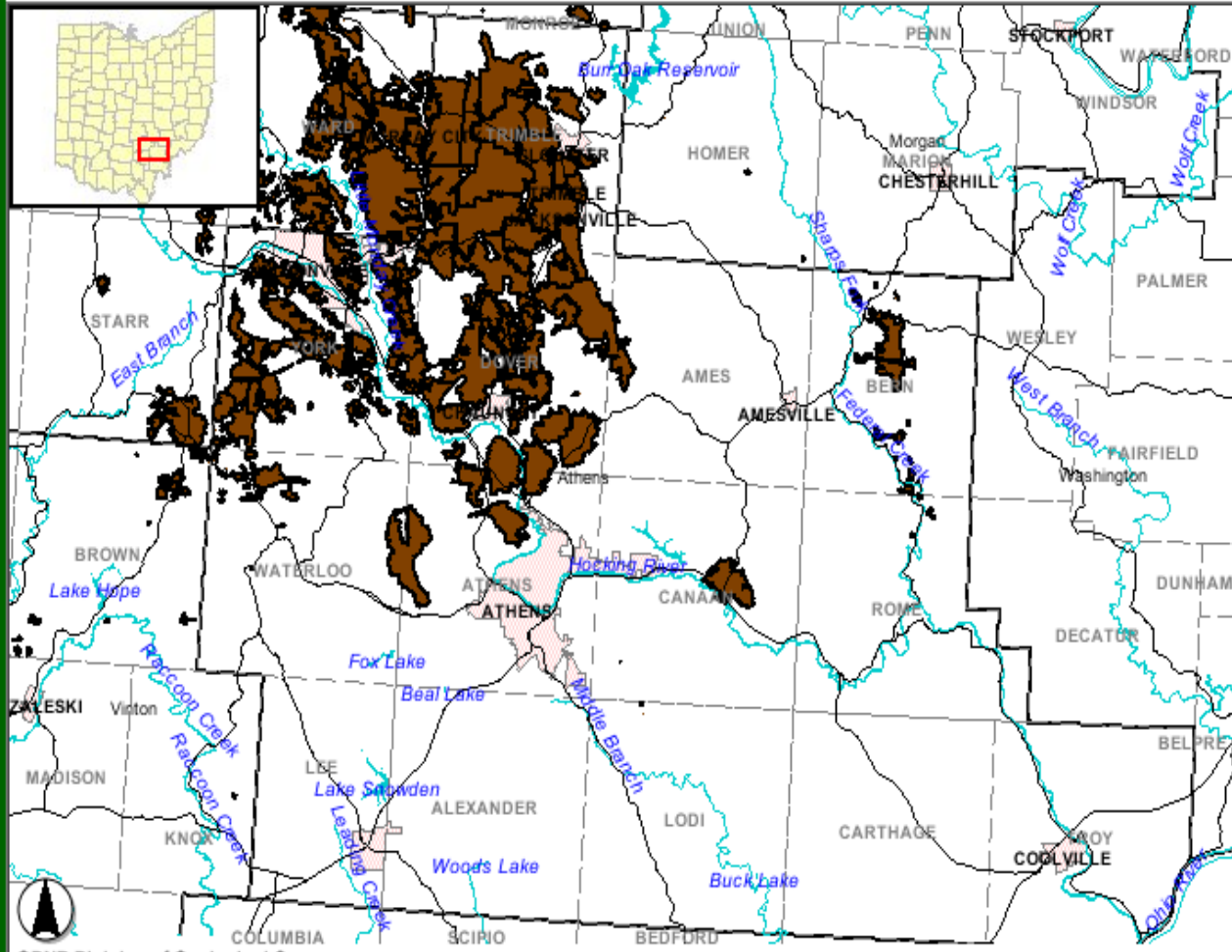


State of Ohio - Abandoned Underground Mine Locator

- Overview
- In
- Out
- Last
- Pan
- Full
- Measure
- Identify
- Query
- Clear
- Print Map
- Help

Locate Address

Refresh Map



- Visible Active
- State Routes Info
 - Interstate Hwy Info
 - Underground Mines Info
 - Underground Mine Extent Partially Unknown Info
 - Rivers Info
 - Lakes Info
 - Cities Info
 - Quad 24K Info
 - Townships Info
 - Counties Info

ODNR Division of Geological Survey

0 4mi

New Interactive Map Available at GeoSurvey Website: <http://www.ohiodnr.com/geosurvey/>
 Then go to "Interactive Maps"

State of Ohio - Abandoned Underground Mine Locator

Overview **In** **Out** **Last** **Pan** **Full** **Measure** **Identify** **Query** **Clear** **Print Map** **Help**

Locate Address

Refresh Map

Visible Active

- Municipal Routes **Info**
- Local Routes **Info**
- State Routes **Info**
- Interstate Hwy **Info**

Mine Openings

- Air Shaft **Info**
- Drift Entry **Info**
- Mine Shaft **Info**
- Slope Entry **Info**

- Underground Mines **Info**
- Underground Mine Extent Partially Unknown **Info**
- Underground Mine Extent Unknown **Info**

- Rivers **Info**
- Lakes **Info**
- Cities **Info**
- Quad 24K **Info**

ODNR Division of Geological Survey

0 2491.29ft

<http://www.ohiodnr.com/geosurvey/> Then go to “Interactive Maps”

Contact Information

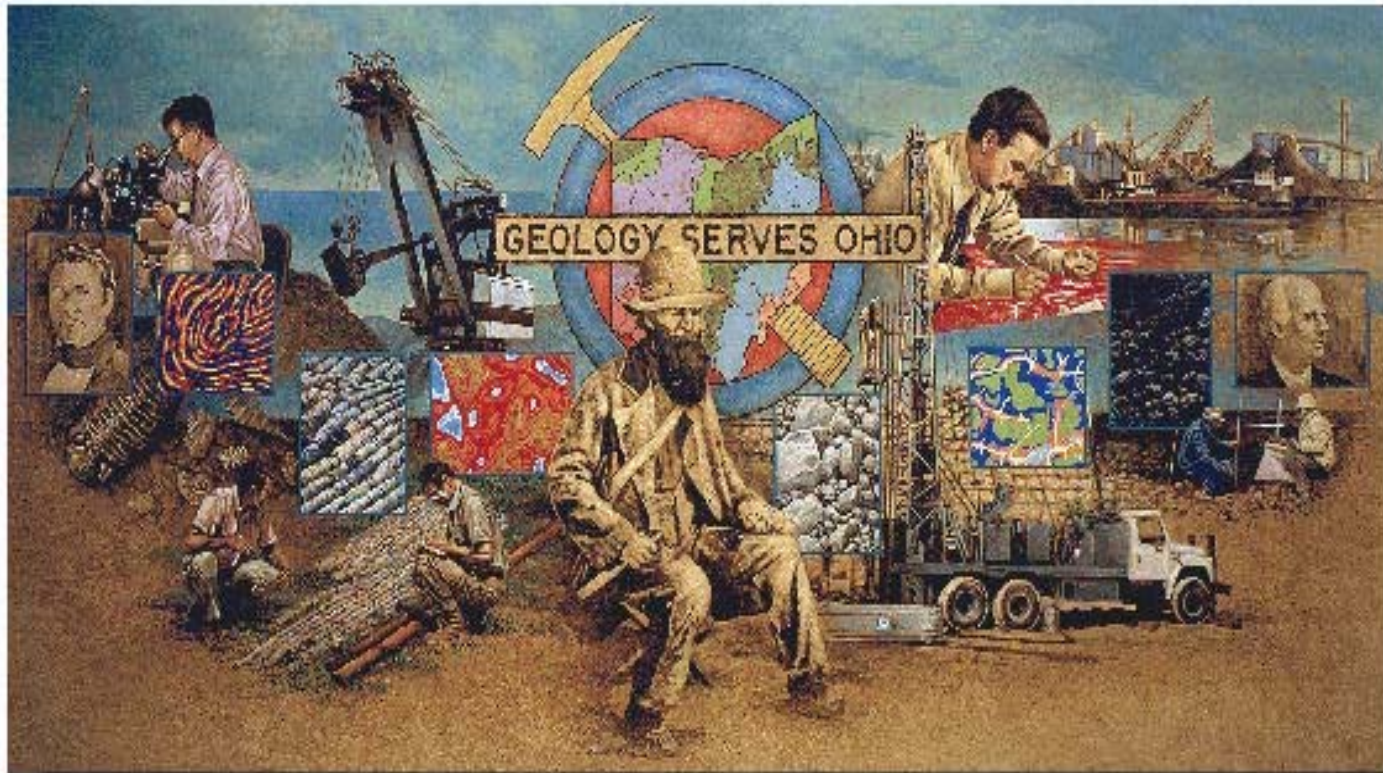
For database details:

Joe Wells
GIMS Database Administrator
Ohio Division of Geological Survey
2045 Morse Rd., Columbus, Oh 43229
614-265-1030
joseph.wells@dnr.state.oh.us

For Program Information:

Larry Wickstrom
Supervisor, Energy Resources Group
(Address as above)
614-265-6598
larry.wickstrom@dnr.state.oh.us





Thank You!



**DIVISION OF
GEOLOGICAL
SURVEY**

**OHIO DEPARTMENT OF
NATURAL RESOURCES**