Data Management for OSMRE Mine Pool Project at Ohio University: Lessons Learned

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Outline

- Project Overview
- Work Flow
- Data Entry
- Quality Assurance/Quality Control
- Data Tracking
- Digitizing Data & ArcGIS Online Map
- Continued Work & Lessons Learned

Project Overview

Title: ‘Tools to predict the hydrological response and mine pool formation in underground mines’

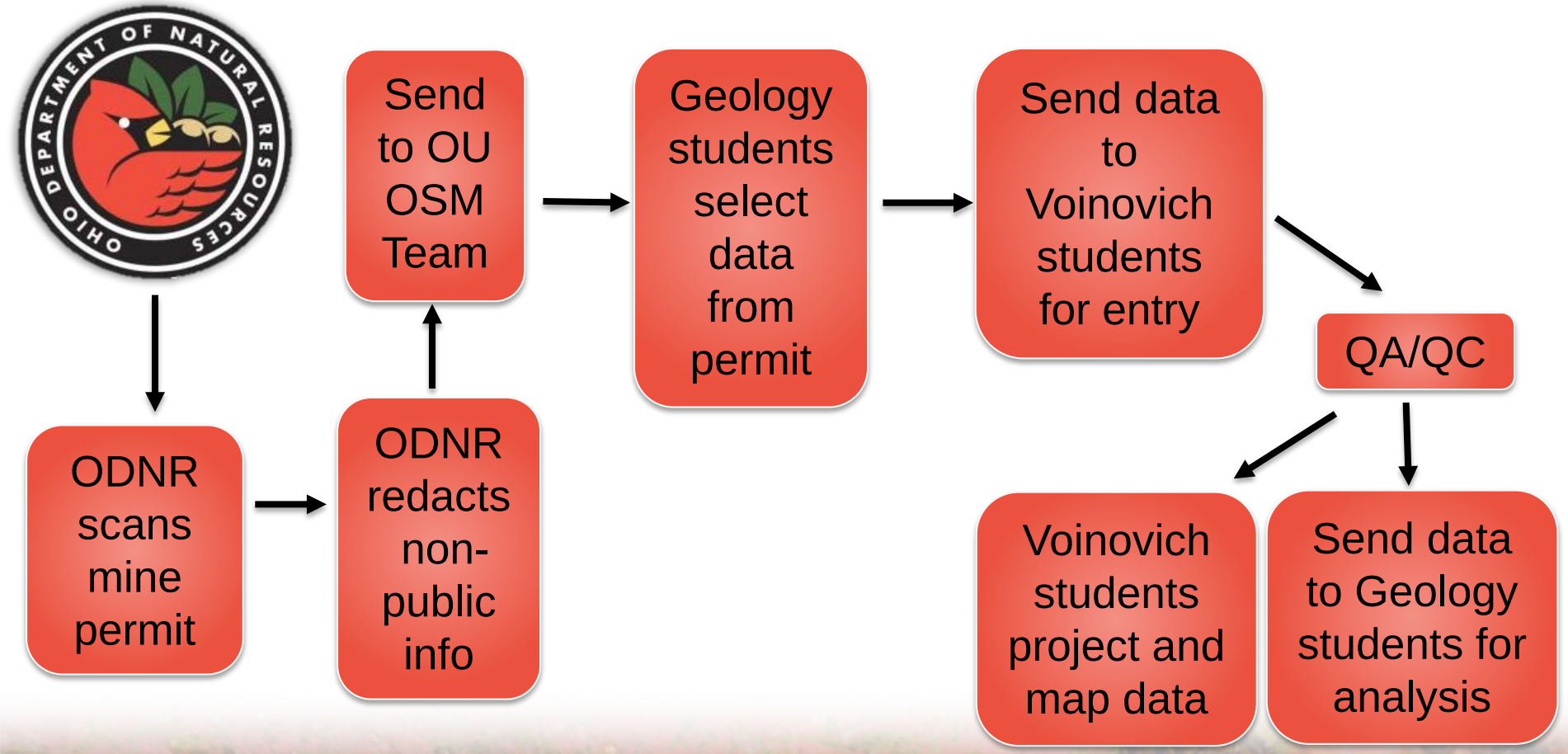
Goal: Produce an ArcGIS tool for prediction of post-mining water level

- Office of Surface Mining Reclamation and Enforcement (OSMRE) funded project with Ohio University Voinovich School & Department of Geological Sciences
- Coal companies lack a reliable method to predict a mine flooding post-closure

Goal for Data Collection

- To collect hydrologic, geologic, and existing mine data for development of database
- Use for better understanding of effects of underground mining
- Combined analysis of data to determine post-mining water levels

Work Flow


ODNR scans mine permit
ODNR redacts non-public info
Send to OU OSM Team
Geology students select data from permit
Send data to Voinovich students for entry
QA/QC
Voinovich students project and map data
Send data to Geology students for analysis

Various Data Sources

- Ohio Department of Natural Resources (ODNR)
  - Online Mine Viewer
  - Online Well Viewer
  - Mineral Resources
  - Geologic Survey
  - Water Resources
- US Environmental Protection Agency (EPA)
  - National Pollutant Discharge Elimination System (NPDES) permits
- All of data obtained is public information

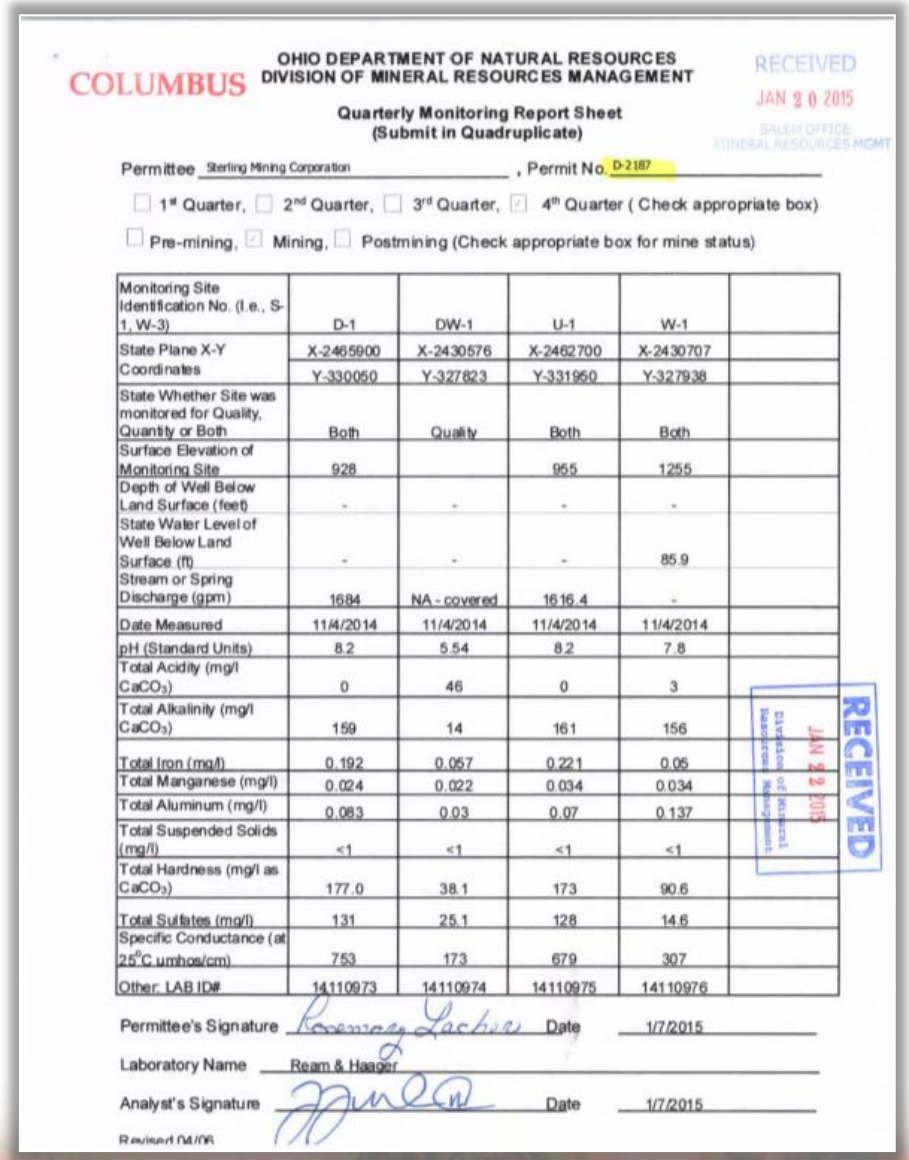
Initial Data Entry

- Well and borehole data are selected from permit file
  - Wells are selected that have static water level (SWL) values
  - Borehole data relevant to the study is selected
  - When possible, boreholes selected form an even geographic distribution
- Data is extracted to a standardized Excel sheet
- Data sheets go through QA/QC process

Secondary Data Entry

- Quarterly Monitoring Report (QMR)

  data is extracted
  - Only for post mining dates
  - Have static water level (SWL) and XY values
  - Standardized Excel sheet like previous wells



COLUMBUS

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

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Quarterly Monitoring Report Sheet
(Submit in Quadruplicate)

Permittee Sterling Mining Corporation , Permit No. D-2187

☐ 1st Quarter, ☐ 2nd Quarter, ☐ 3rd Quarter, ☑ 4th Quarter (Check appropriate box)

☐ Pre-mining, ☑ Mining, ☐ Postmining (Check appropriate box for mine status)

Monitoring Site Identification No. (I.e., S-1, W-3)	D-1	DW-1	U-1	W-1	
State Plane X-Y Coordinates	X-2465900	X-2430576	X-2462700	X-2430707	
	Y-330050	Y-327823	Y-331950	Y-327938	
State Whether Site was monitored for Quality, Quantity or Both	Both	Quality	Both	Both	
Surface Elevation of Monitoring Site	928		955	1255	
Depth of Well Below Land Surface (feet)	-	-	-	-	
State Water Level of Well Below Land Surface (ft)	-	-	-	85.9	
Stream or Spring Discharge (gpm)	1684	NA - covered	1616.4	-	
Date Measured	11/4/2014	11/4/2014	11/4/2014	11/4/2014	
pH (Standard Units)	8.2	5.54	8.2	7.8	
Total Acidity (mg/l $CaCO_3$)	0	46	0	3	
Total Alkalinity (mg/l $CaCO_3$)	159	14	161	156	
Total Iron (mg/l)	0.192	0.057	0.221	0.05	
Total Manganese (mg/l)	0.024	0.022	0.034	0.034	
Total Aluminum (mg/l)	0.083	0.03	0.07	0.137	
Total Suspended Solids (mg/l)	<1	<1	<1	<1	
Total Hardness (mg/l as $CaCO_3$)	177.0	38.1	173	90.6	
Total Sulfates (mg/l)	131	25.1	128	14.6	
Specific Conductance (at 25°C umhos/cm)	753	173	679	307	
Other: LAB ID#	14110973	14110974	14110975	14110976	

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Permittee's Signature Rosemary Lachina Date 1/7/2015

Laboratory Name Ream & Haager

Analyst's Signature Date 1/7/2015

Revised 04/06

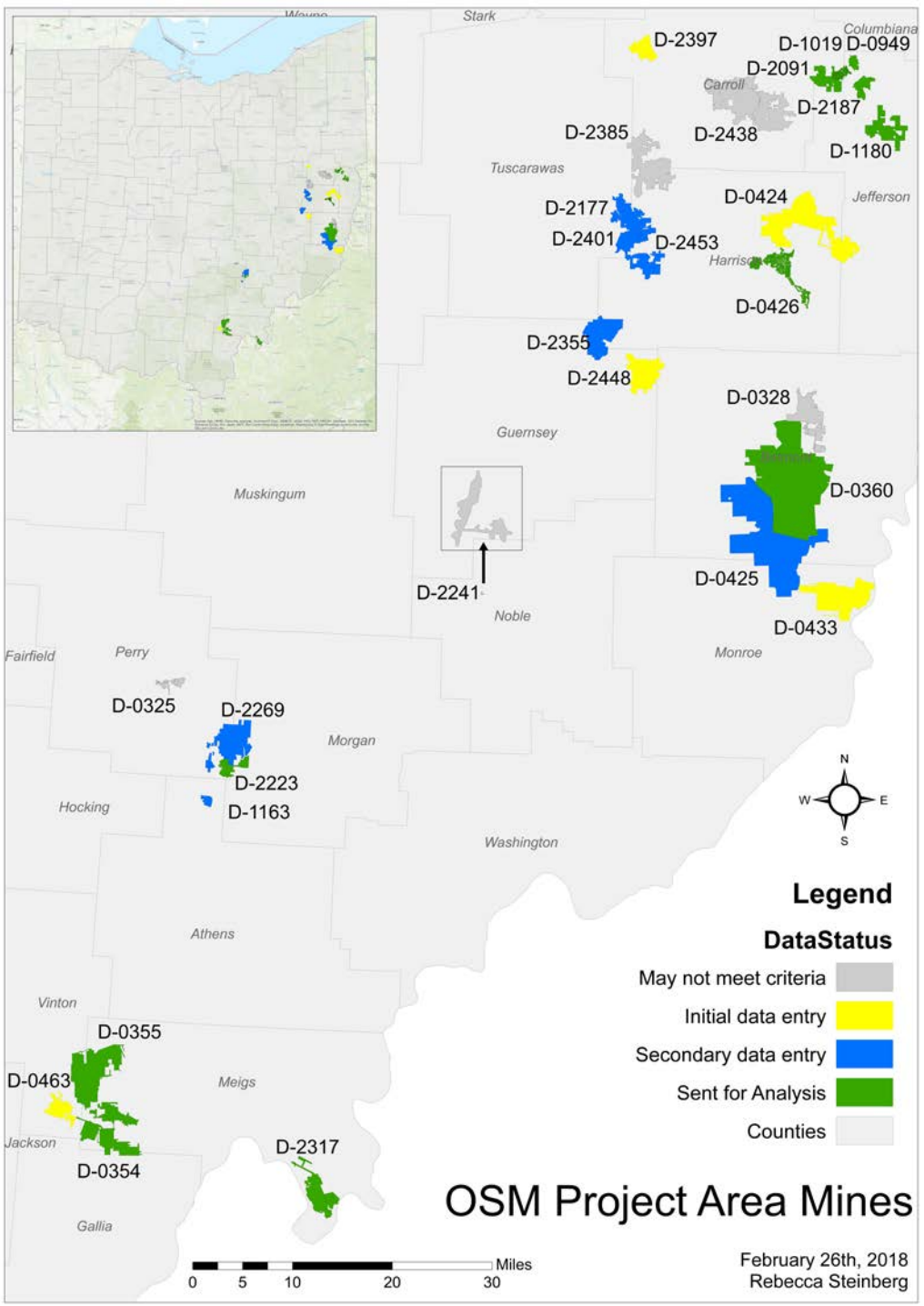
Quality Assurance/Quality Control

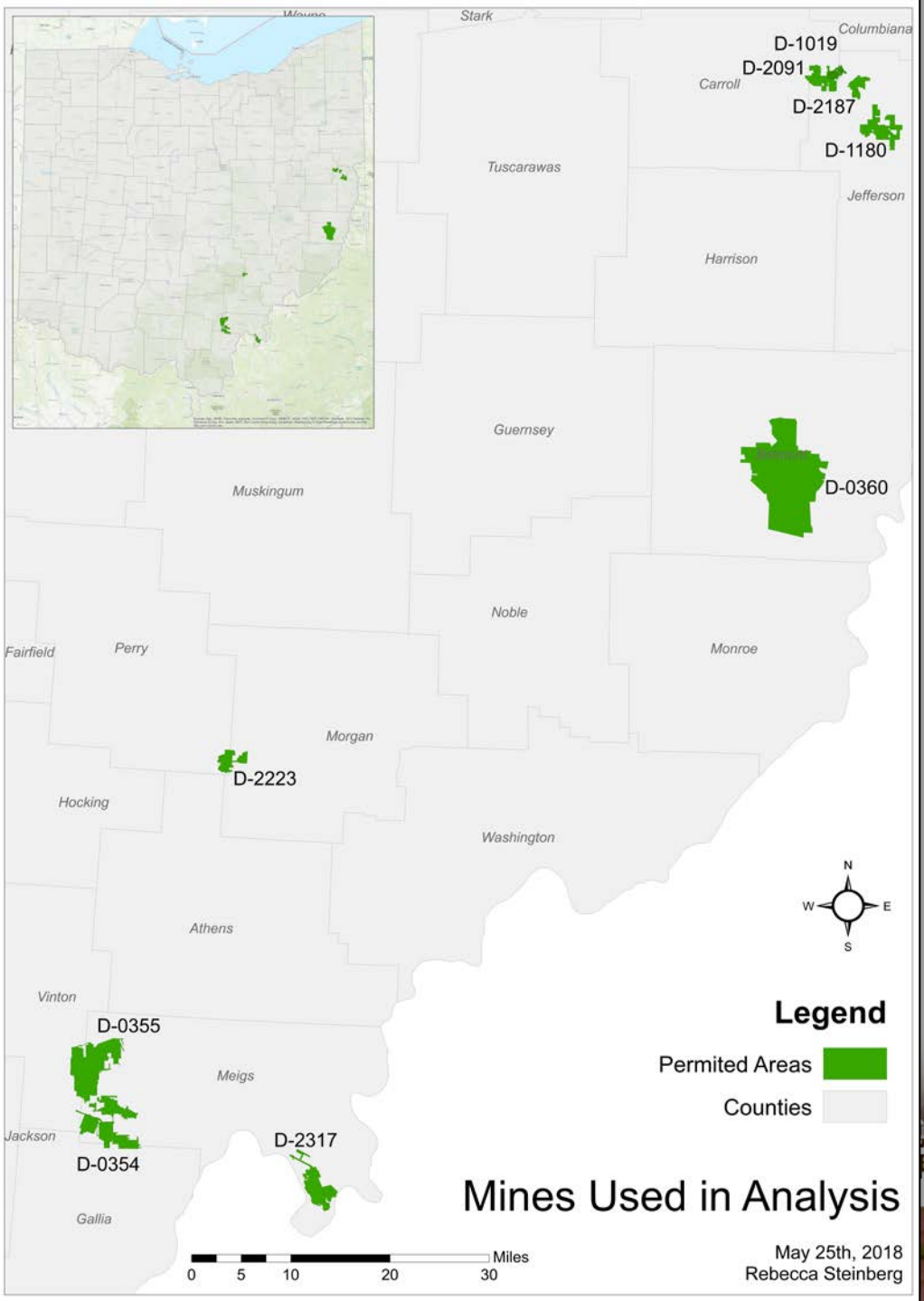
- Completed by student that did not select or enter data
- ~10% of the data is checked to find & correct mistakes
- Several methods for finding inconsistencies
  - Borehole lithology percentages are totaled to look for outliers, far from 100%
  - Elevations, SWL, depth from surface values are sorted to look for outliers
- New Qc'd Excel is uploaded, used for digitizing points

Data Tracking

- Needed for communication
  - Team members with differing schedules
  - Extensive amount of complex data to organize and format
- Tracking through shared Excel sheets
- Easy reference for:
  - Who is entering data and when they finish
  - Tracks stage of entry of each permit

Permit Number:	**D-2091**	
Mine Name:	**Carrol Hollow**	
Company:	Sterling Mining Co	
Start - End Mining:	3/2/2001 to 3/1/2016	
Permited area acreage:	3081	
Mined out extent in shapefile?	Y/N:	Yes
	Acres:	422 (134)
Mining status: (Active, Idle, Sealed):	Sealed	
Number of wells (with data):	34	
Number of boreholes (with data):	34	
Coal seam mined:	Name:	Middle Kittanning, (Upper Freeport)
	Number:	6, (7aD2091-4)
Coal Seam Raster? (Y/N):	Y (Y)	
Water withdrawal points:	Name:	None
	Number:	
Near-mine acreage in buffer:	1 mile:	925
Abandoned	2 mile:	2,335
	4 mile:	6,385
Near-mine acreage in buffer:	1 mile:	783.49
Post-SMCRA	2 mile:	1963.61
	4 mile:	4796.57
Closest borehole to each well done? (Y/N):	Yes	



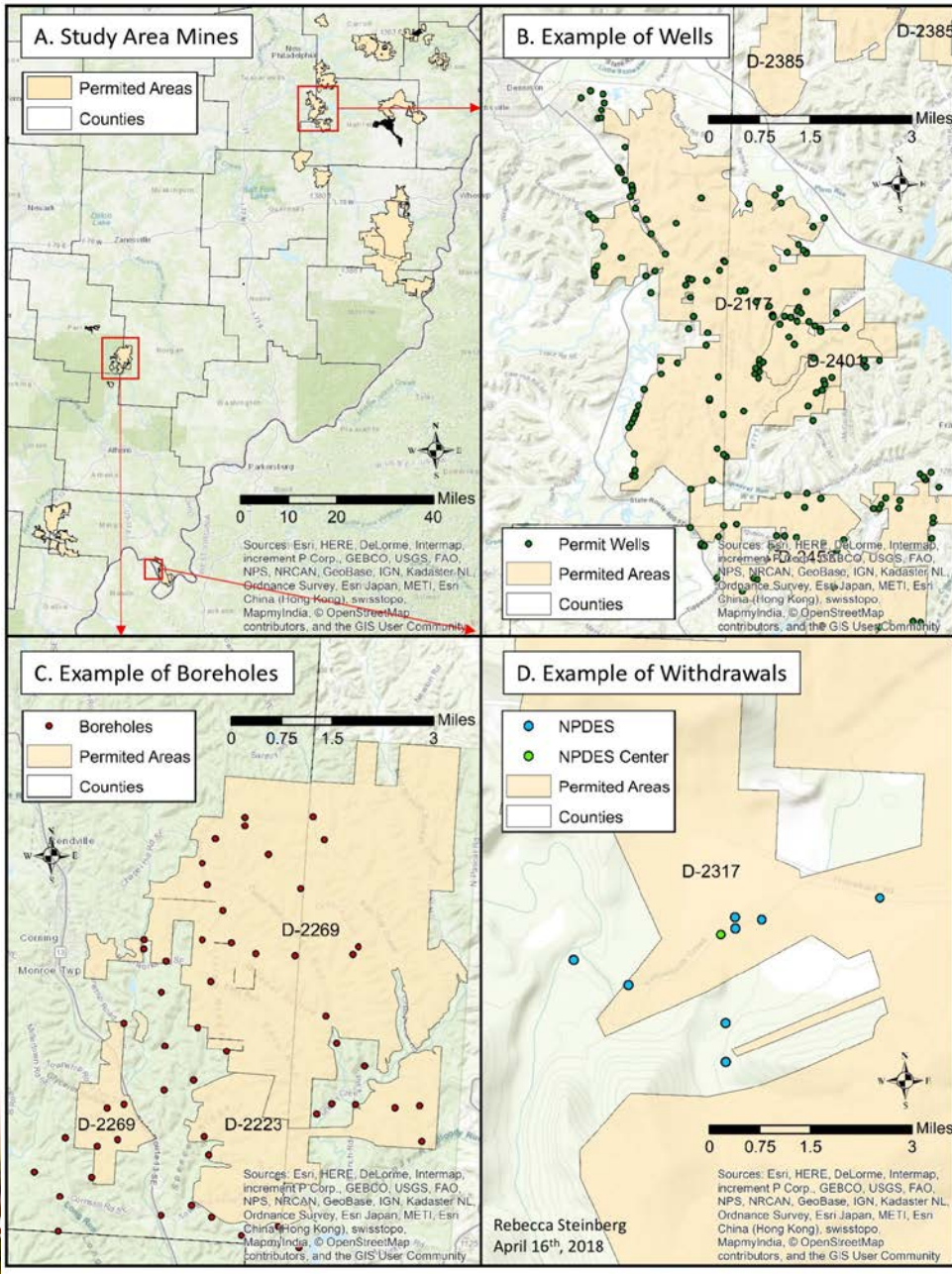


*9 of 28 mines were used in full analysis:

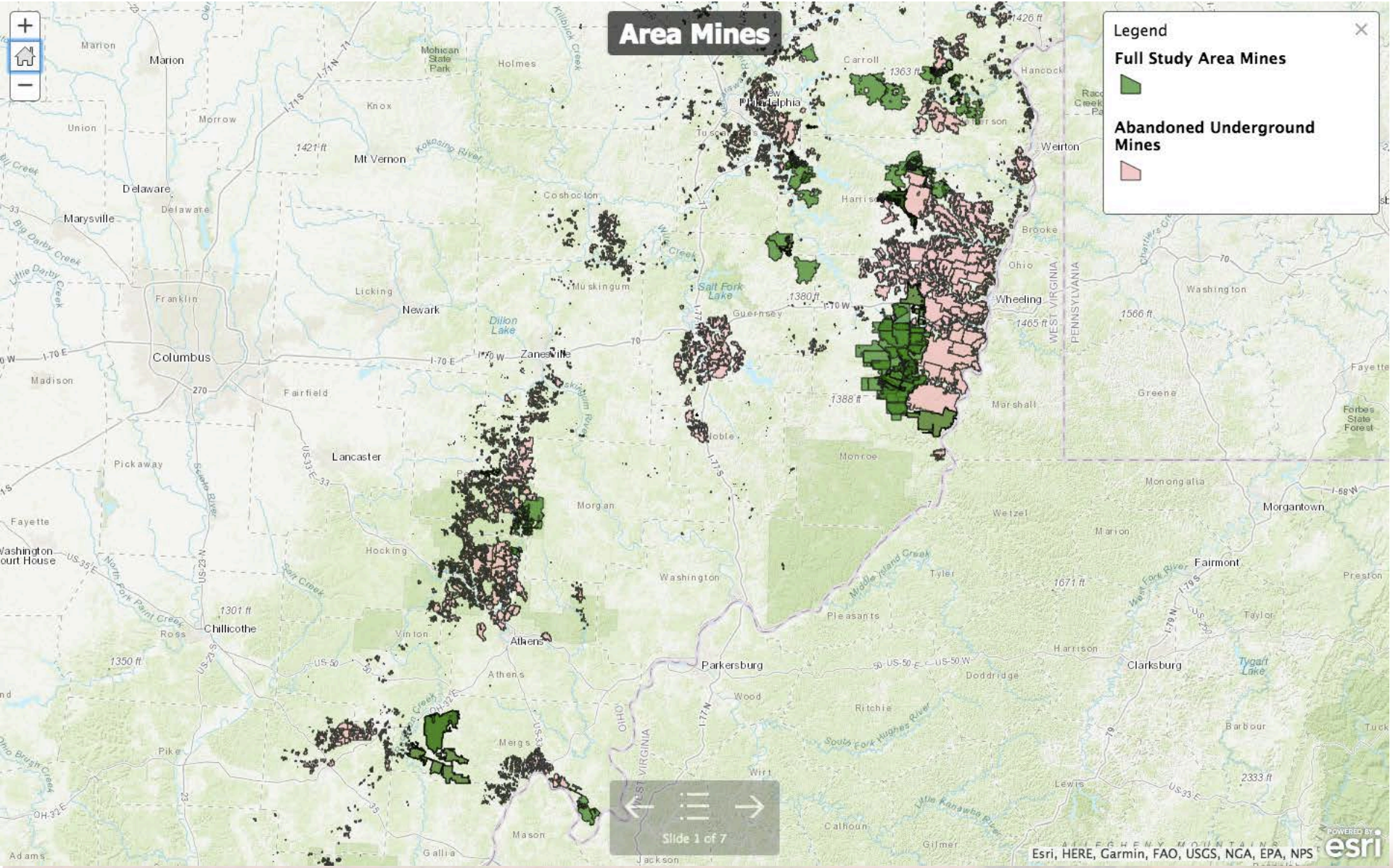
Required complete data sets and non-active mines

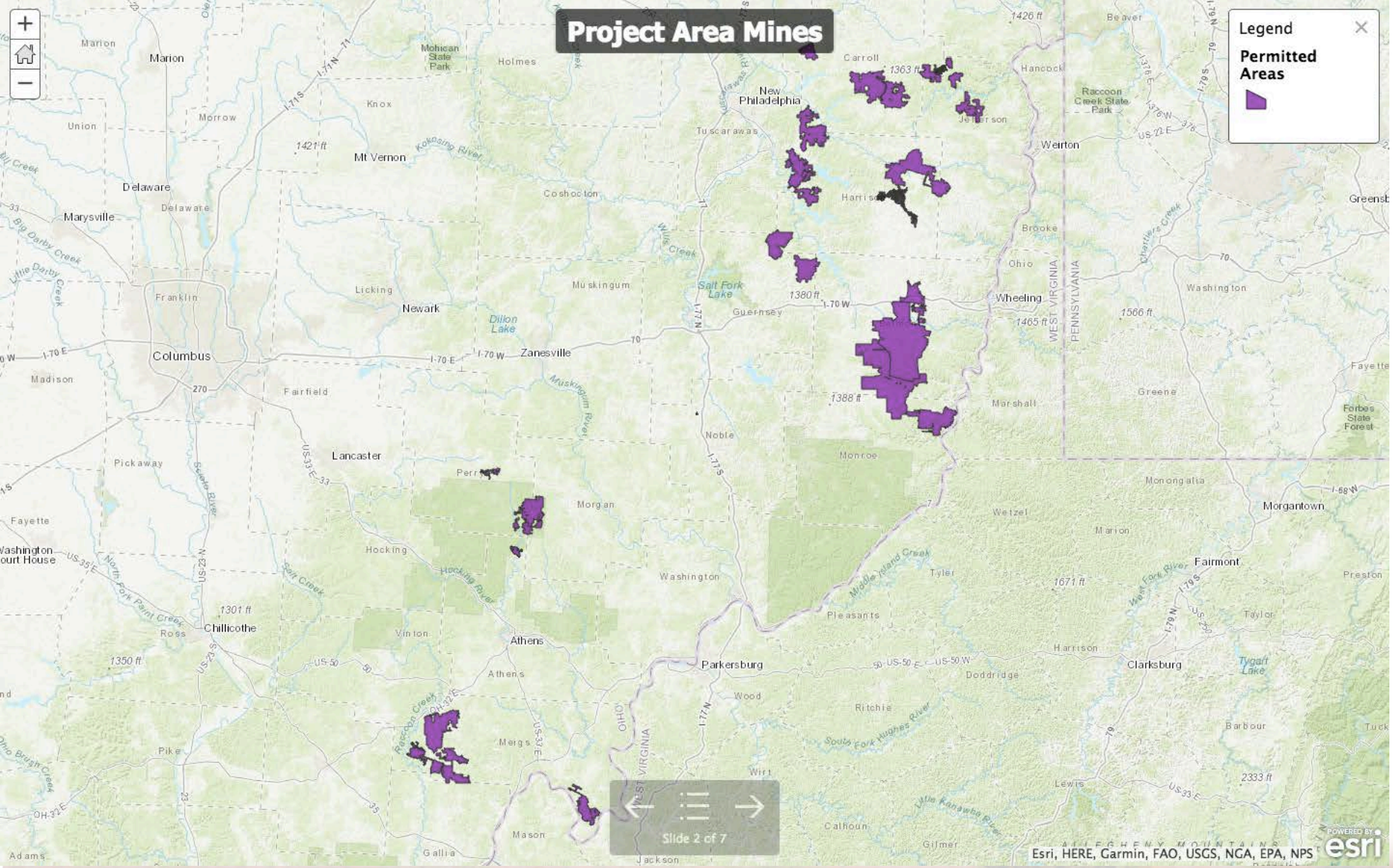
Digitizing Data & ArcGIS Online

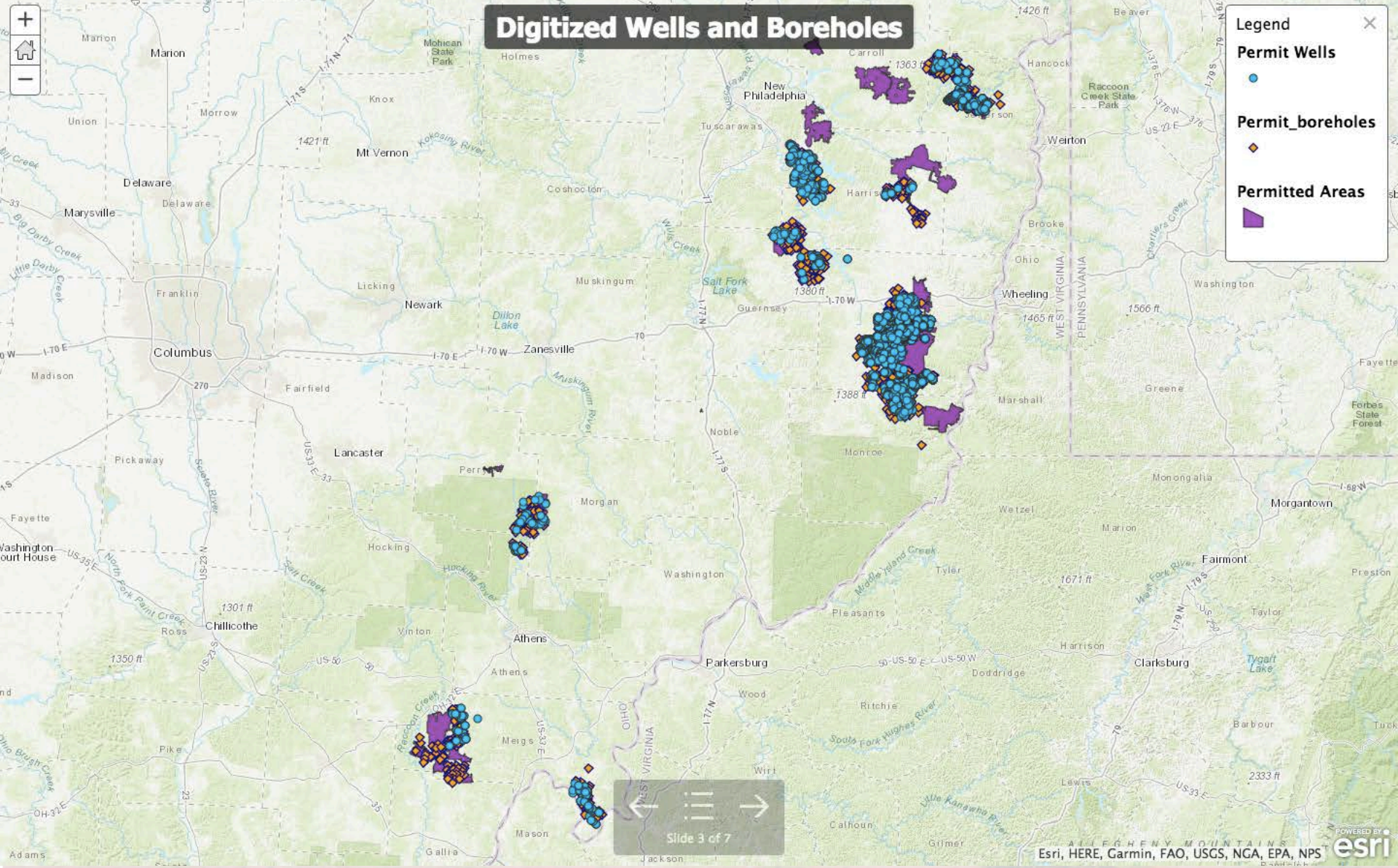
- QA/QC sheets are projected into ArcMap as a shapefile
  - Will be used for creating ArcGIS tool
- Added to ArcGIS Online for easy reference
- ArcGIS Online was used to make selections of boreholes and wells pulled from the permit files

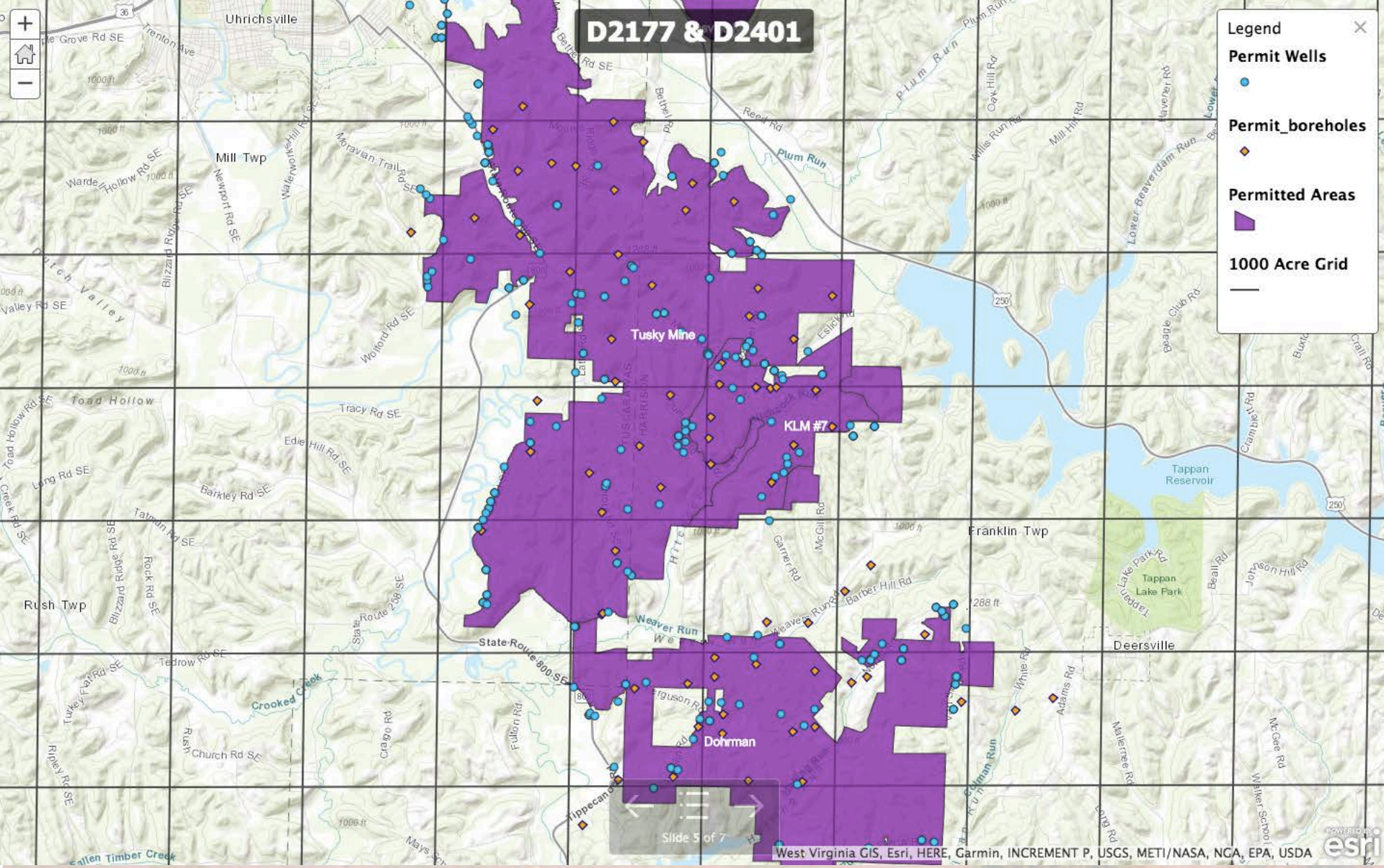


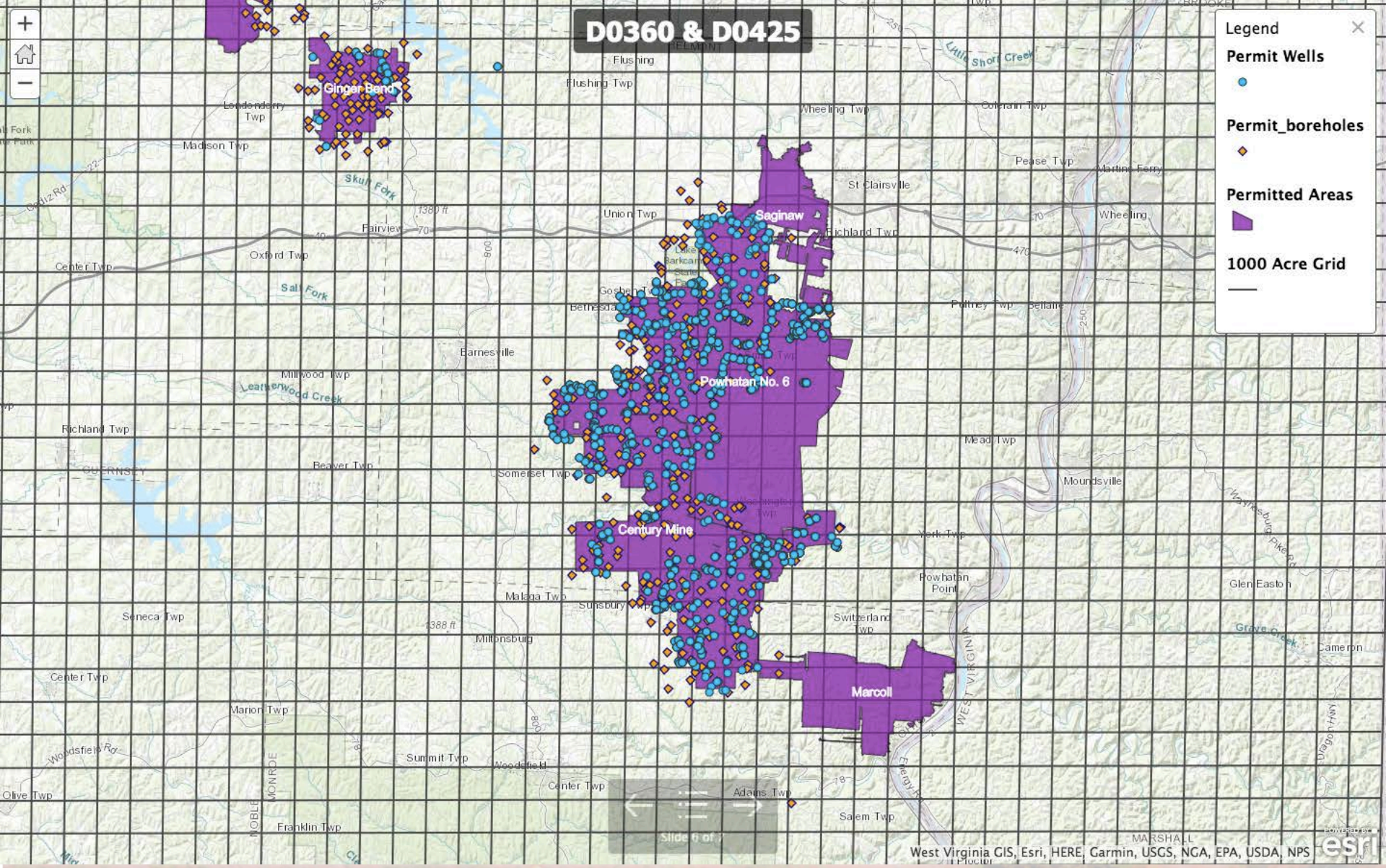
http://ohiou.maps.arcgis.com/apps/presentation/index.html?webmap=c6c5d88d17744e85b131b9e465143747&slide=1

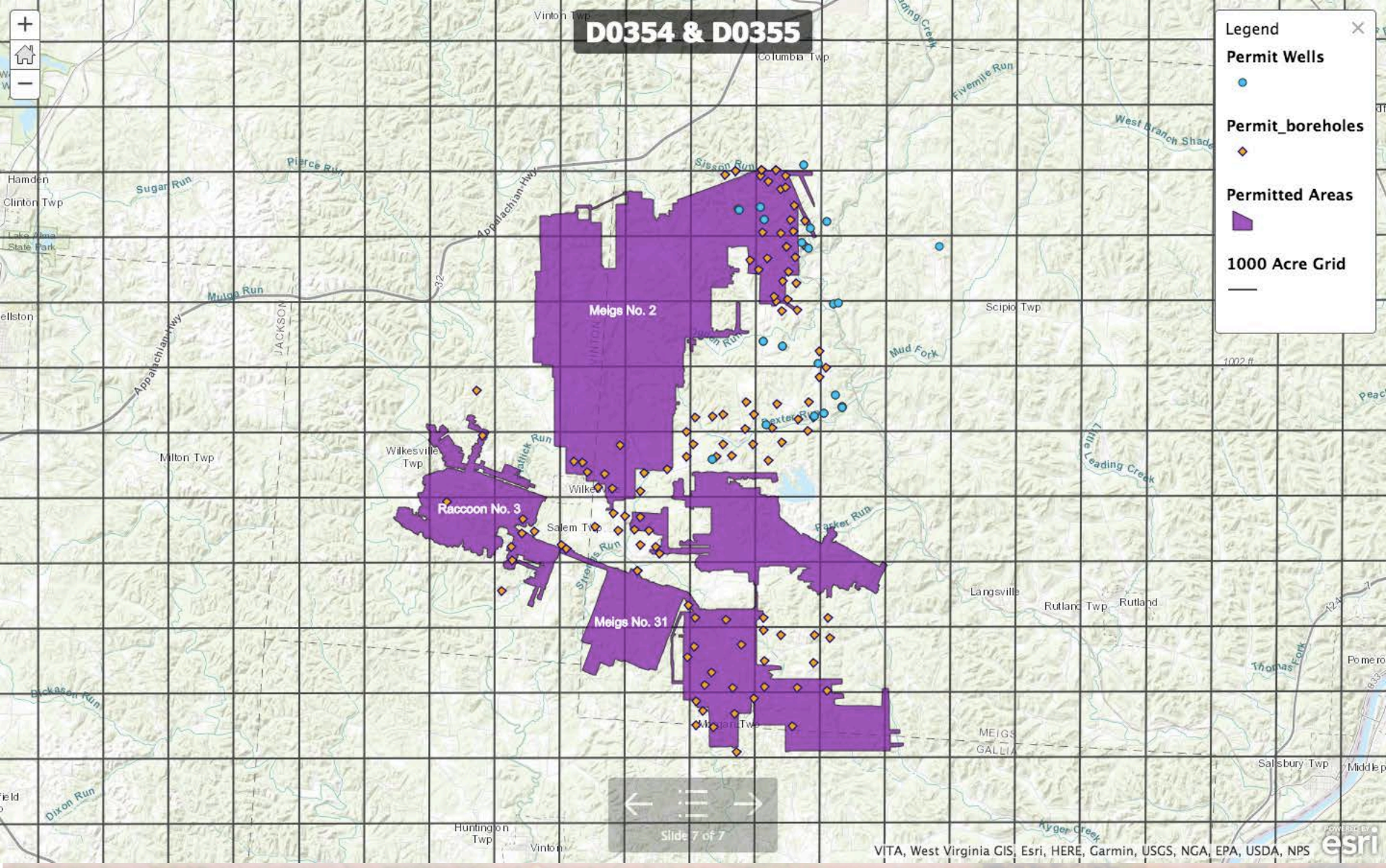






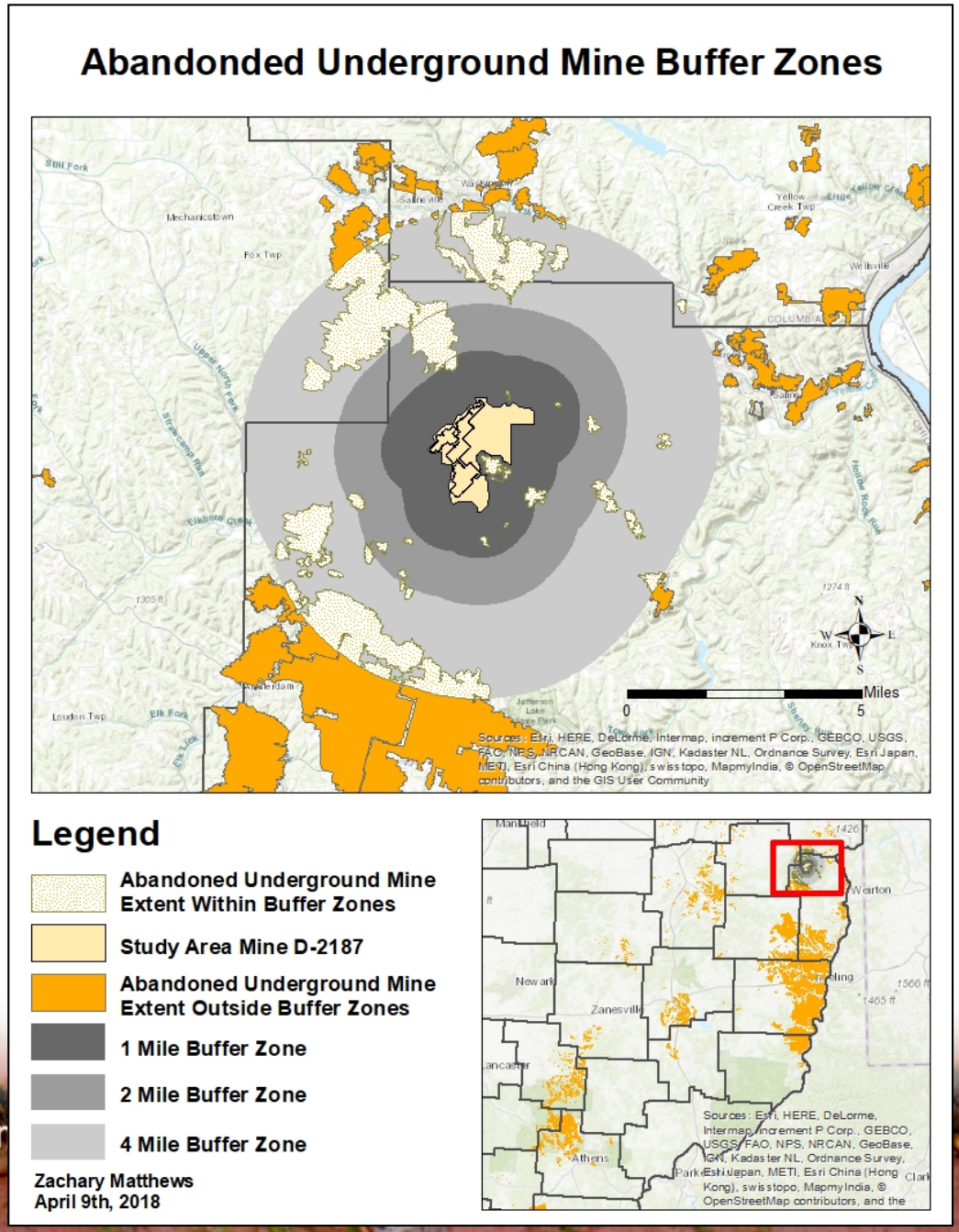






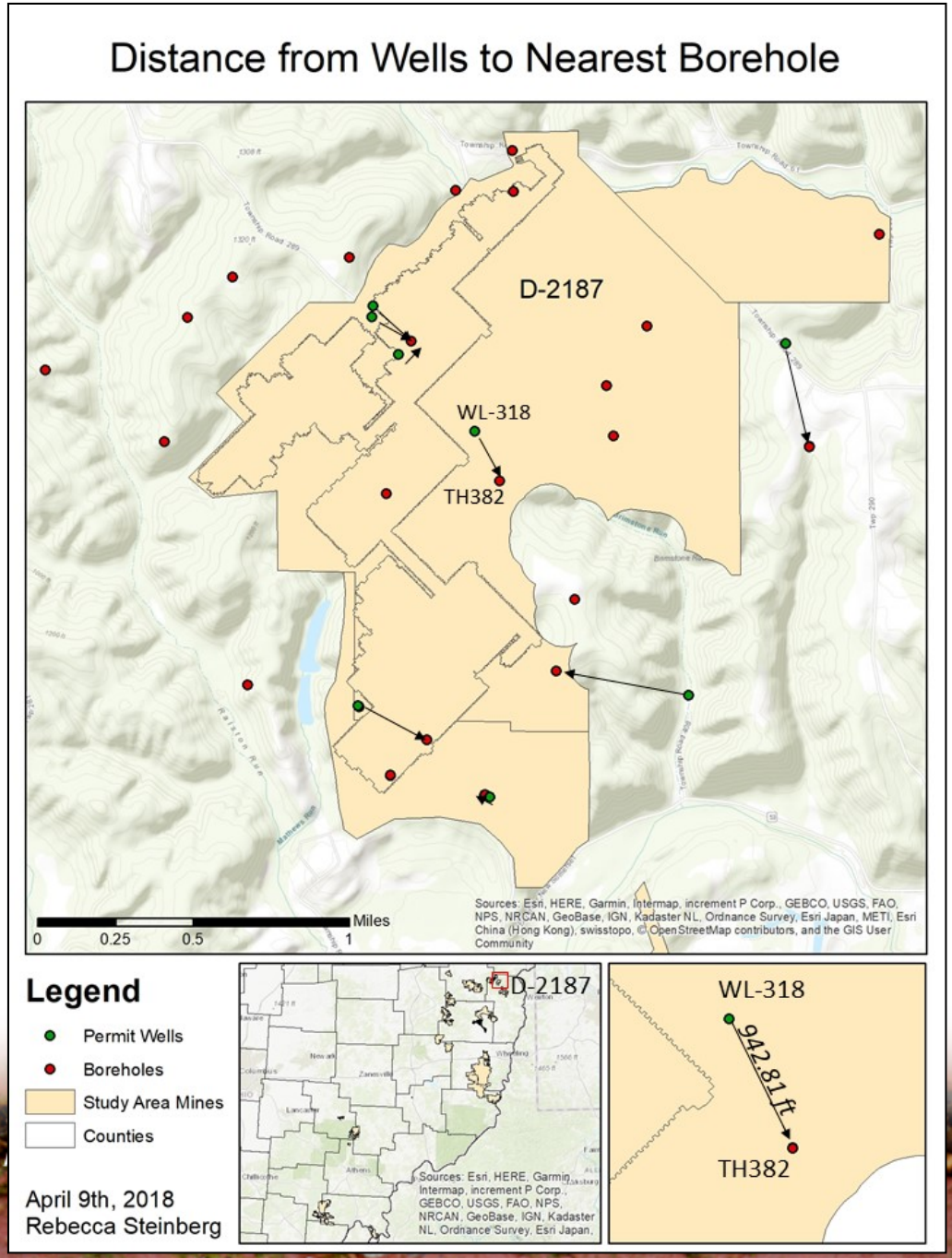
ArcGIS Produced Data

- Acreage of nearest mines within 1, 2, and 4 mile buffers
- Acreage of all mines
- Calculated buffer areas for both abandoned mines and other study mines



ArcGIS Produced Data

- Identified nearest borehole to each well
- Calculated distance to borehole
- Used for lithological reference for each well in analysis



Data and Formats Provided

Excel	Shapefile	ArcGIS	Misc. Uses for Analysis
Borehole & Well Data	Boreholes & Wells	Borehole & Well Study Area Layer	1000 Acre Grid
QA/QC Borehole & Well Data	Water Withdrawal Points	Buffered & Clipped Surrounding Mine Area	Points for Surfer Map
Entered QMR data	Selection of Mine Area Extents	Various Point Distance Calculations	Points for MODFLOW
QA/QC of QMR		ArcGIS Online map for viewing	Maps of Mines Analyzed
Real-time Summary Sheets of Each Mine			

Continued Work

- Determine format for files needed in tool creation
- Finish development of geodatabase of collected data
- Create GIS tool from analyses and distribute
- Maintain organization of data for future research and application
- Analyze abandoned underground mines

Lessons Learned

- Communication and organization are key
- Takes time to develop a method for management
- Make realistic timelines
- Priorities between team members can differ
- Exciting/rewarding to see everything coming together!

Questions?

- Thank you to OSMRE and steering committee
- And all team members at Ohio University:
  - Dr. Natalie Kruse
  - Dr. Dina Lopez
  - Jen Bowman
  - Nora Sullivan
  - Rob Delach
  - Lindsey Schafer
  - Fred Twumasi
  - Zack Matthews
  - Undergraduate Voinovich scholars