



pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES



Central Appalachian Partnership (CAP) for Carbon Storage Deployment

DEFE0032394

August 5, 2024

Michele L. Cooney, P.G.

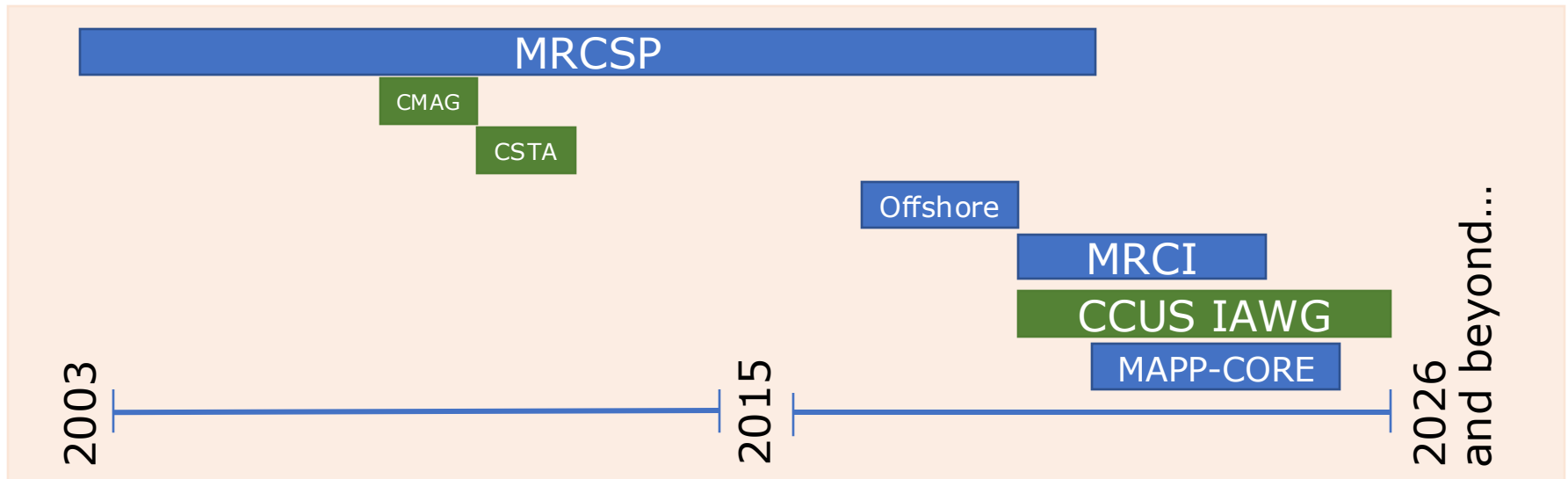
Pennsylvania Geological Survey, Pittsburgh, PA




Central Appalachian Partnership
for Carbon Storage Deployment

PA Survey's Work in CCUS


- Midwest Regional Carbon Sequestration Partnership (MRCSP): 2003 – 2019 (published 2020)
- Carbon Management Advisory Group (CMAG): 2008
- Carbon Sequestration Technical Assessment (CSTA): 2009
- Mid-Atlantic U.S. Offshore Carbon Storage Resource Assessment: 2016 – 2019
- Midwest Regional Carbon Initiative (MRCI): 2019 – 2024
- Governor's CCUS Inter-Agency Work Group: 2019 – present
- Mid-APPalachian Carbon Ore, Rare Earth and Critical Minerals (MAPP-CORE) Initiative: 2021 – 2024
- **Central Appalachian Partnership (CAP) for Carbon Storage Deployment: 2024 - 2026**



Project Overview



WVGES
GEOLOGY UNDERLIES IT ALL



Task 1: Project Management & Planning
 PI: Michele Cooney (PAGS)
 PA Project Manager: Kristin Carter (PAGS)
 WV Project Manager: Jessica Moore (WVGES)

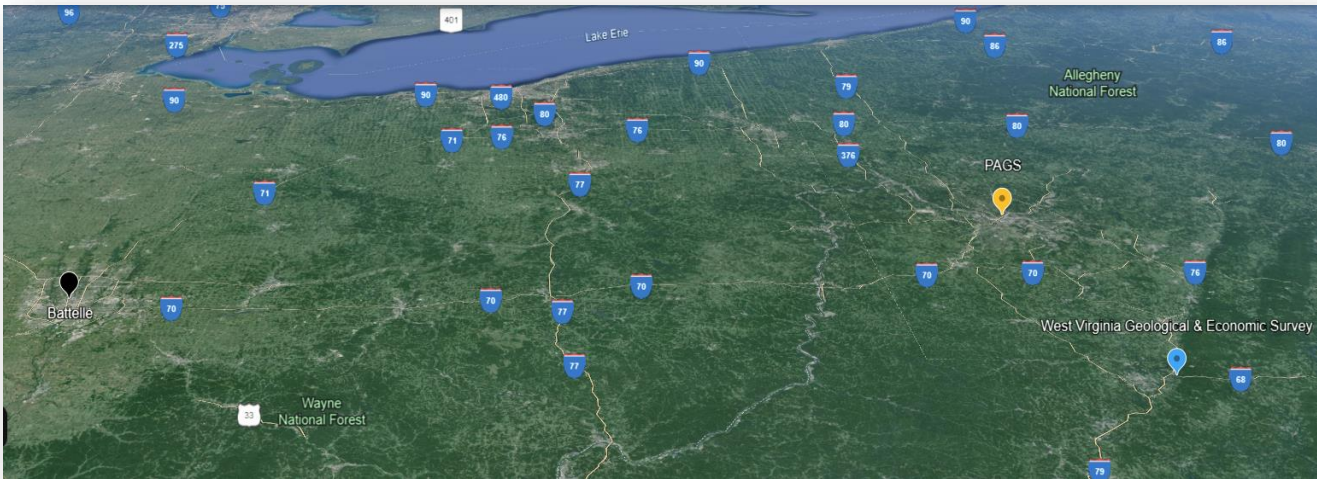
Task 2: Societal Considerations and Impacts (SCI)
 Joy Frank-Collins (Battelle) - Outreach Lead
 Jared Hawkins (Battelle) - SCI Lead

Task 3: Data Crosswalk and Conceptual Geologic Model Development
 Michele Cooney - PAGS Lead
 Jessica Moore - WVGES Lead

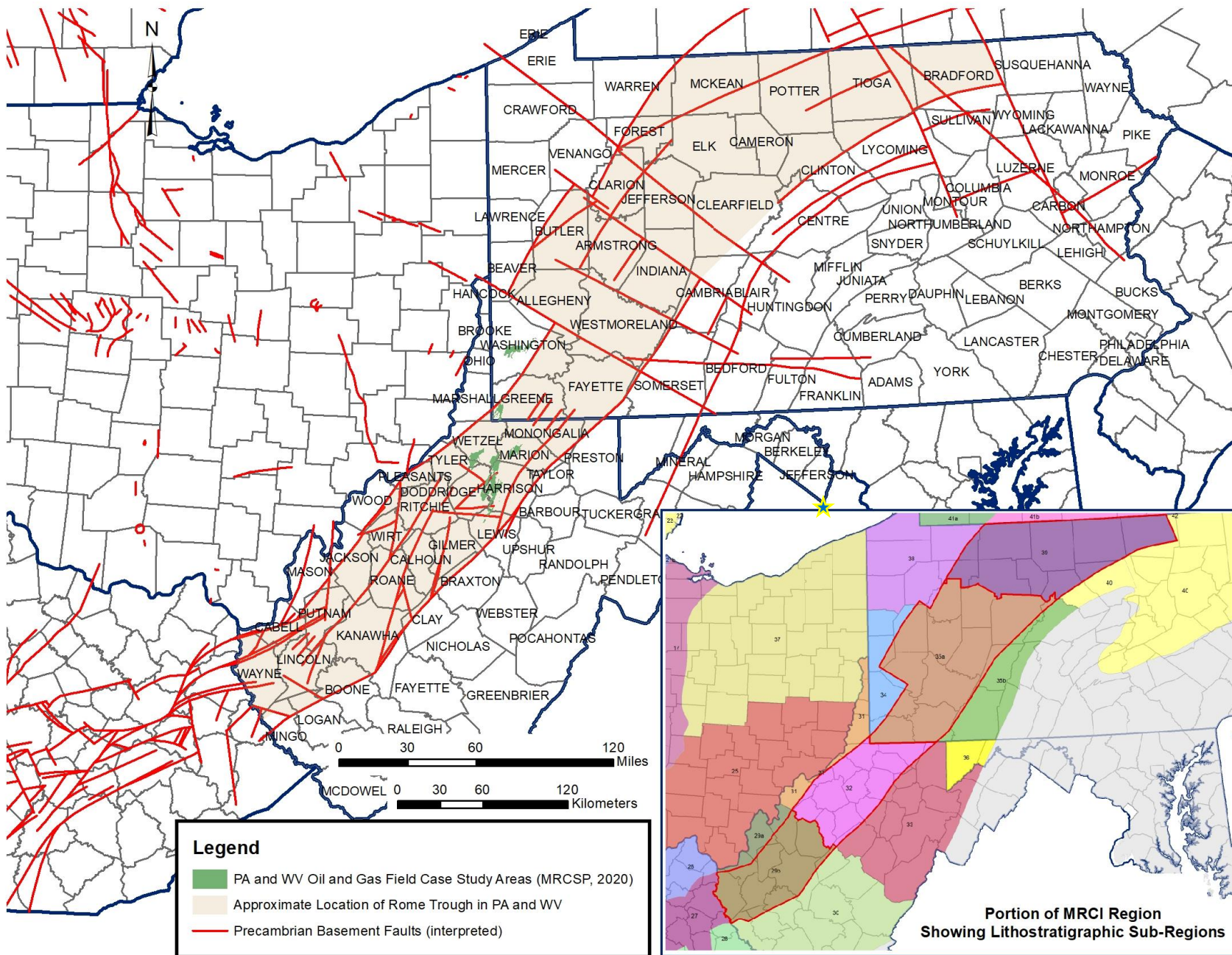
Task 4: Strategic Data Acquisition for Key Geologic Samples
 John Neubaum - PAGS Lead
 Bethany Royce - WVGES Lead

Task 5: Web-based Tool Development
 Al Guiseppe - PAGS Lead
 Richard Binns - WVGES Lead

Task 6: Technology Transfer & Public Outreach
 Lead: Joy Frank-Collins (Battelle)



Project Overview



Project Background

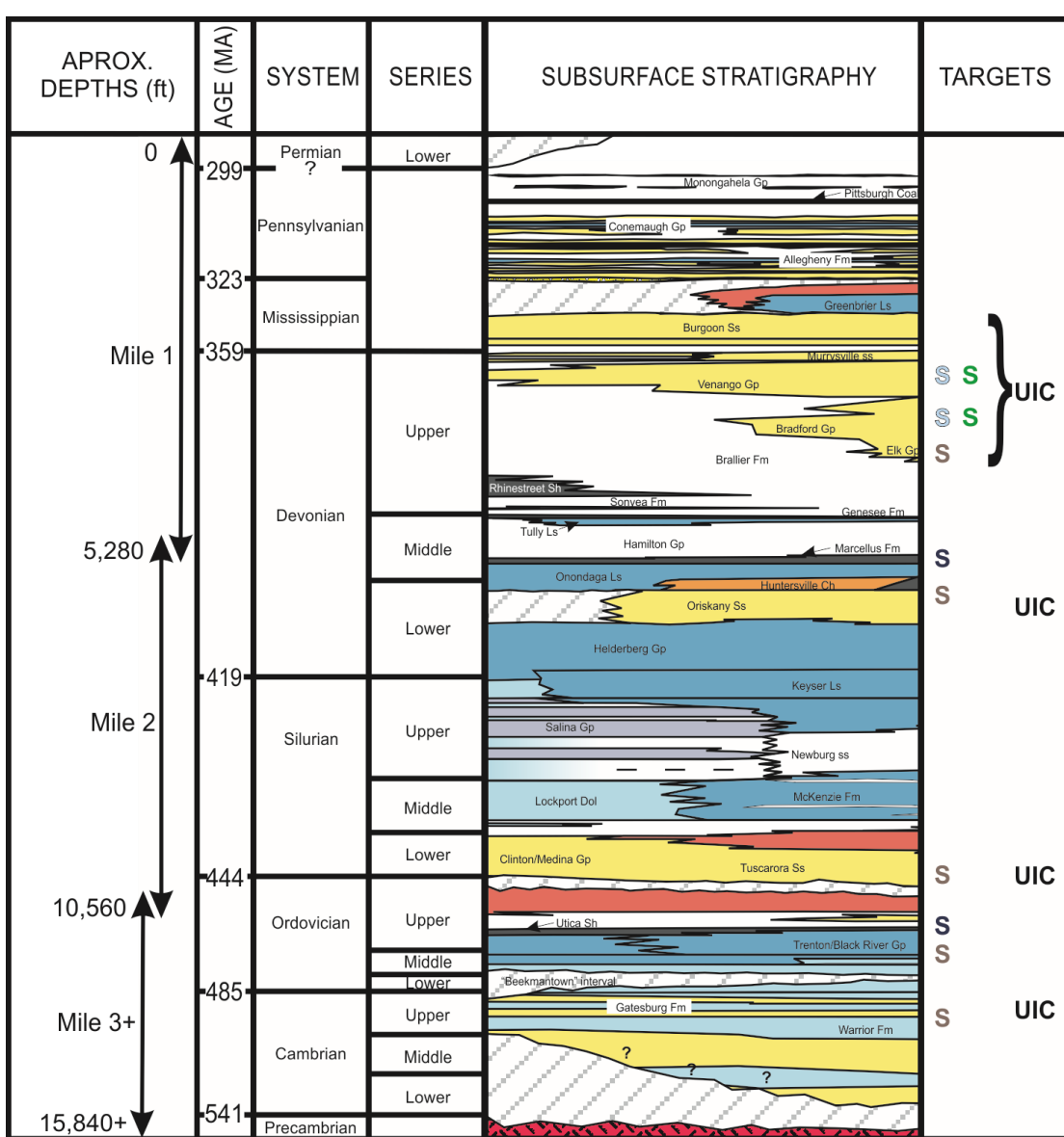
- First mile – existing oil and gas production, natural gas storage, UIC wells, with opportunities for CO₂-EOR and CO₂-EGR with associated storage
- Second mile – some knowledge
- Third mile – little knowledge



Exploration Wells
Development Information
Network (EDWIN)

275,851 wells of record

Sample Studies
Greene: 11
Washington: 7
Fayette: 31
Westmoreland: 138



LEGEND

Predominant lithology

	Conglomerate		Red beds		Chert
	Sandstone		Coal		Evaporite
	Siltstone or shale		Limestone		Crystalline basement rock
	Organic-rich shale		Dolostone		Unconformity

181 – completion reports in EDWIN as of 7/29/24

Stacked carbon storage targets

	Miscible/immiscible EOR with eventual CCS		Organic-rich shale EGR
	Miscible/immiscible EGR with eventual CCS		CCS

UIC Class II UIC injection formation

Project Overview

CAP Project Goal

“The main goal of the CAP Project is to **reduce barriers** for entry to carbon storage project opportunities, particularly in the deepest parts of the Appalachian basin, by **promoting** a better understanding of the study area’s subsurface geologic resources and supporting Class VI UIC injection well permit application needs, thereby **accelerating** the deployment of CCUS at all scales (individual projects to carbon management hubs) in the Appalachian basin.”

Web-Based Tool

What it will include:

- Geologic and technical data
- Free publicly accessible map products
- Free publicly accessible well data
- Core photographs
- Imagery-based analytical data
- UIC data

Who will use it:

- The public, community partners, universities, other state agencies

What it will be used for:

- Geologic natural resource assessment needs
- Carbon storage project opportunities
- Understanding of UIC activities

Project Overview

Performance Dates: January 15, 2024 – January 14, 2026

Total funding:
\$998,011

Total Cost Share:
\$387,188



\$262,188 cost share



\$584,284
\$125,000 cost share



\$79,148

Work Breakdown Structure	FY2024												FY2025				FY2026									
	Q2			Q3			Q4			Q1		Q2		Q3		Q4		Q1		Q2						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Task 1 - Project Management and Planning	!	D					!					!		!							!	!	!			
1.1 - Progress Meetings (virtual)	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
1.1 - Quarterly Reporting (internal)				R			R			R			R			R			R			R			R	
1.2 - Technical Reports (to DOE)				R			R			R			R			R			R			R			R	
1.3 - Final Reporting (to DOE)																									R	
1.4 - Project Meetings (In person)												M									M					
Task 2 - SCI Assessment and Plans			M								M							M								
2.1 - DEIA Plan			!												S	S	S	S								
2.2 - Justice40 Plan			!																							
2.3 - Community/Stakeholder Plan			!																							
Task 3 - Data Crosswalk and Geologic Model							D				D															
3.1 - Data Crosswalk							!																			
3.2 - Conceptual Model											!															
Task 4 - Strategic Data Acquisition															D	!					D		!	!		
4.1 - Data Gap Analysis																										
4.2 - Laboratory Analyses																										
Task 5 - Web-Based Tool																					D					
5.1 - State-Specific Information																										
5.2 - UIC Data for Permit Applications																										
Task 6 - Technology Transfer & Outreach																										

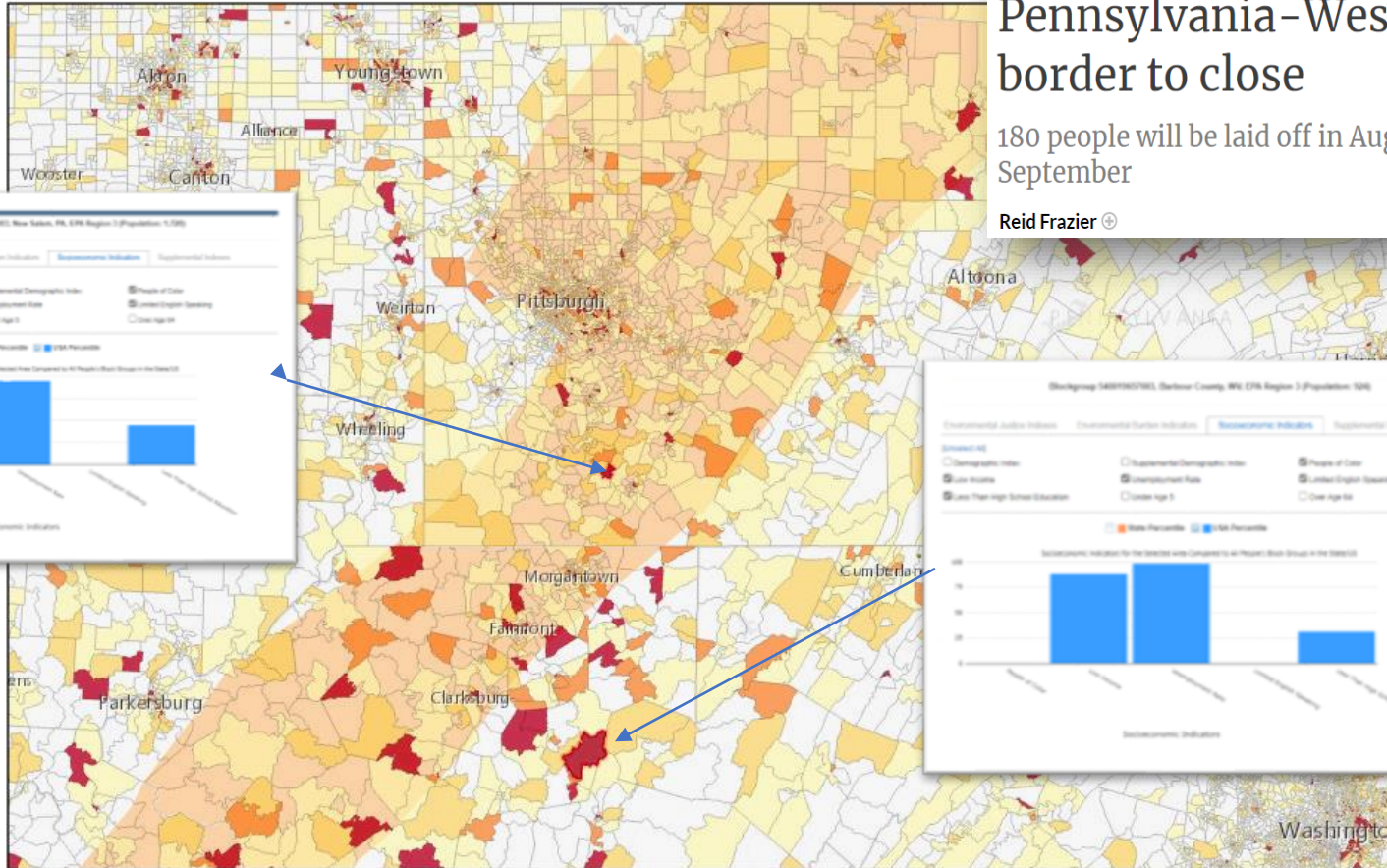
(! – Milestone; M – Meeting; R – Report; D – Decision Point; S - Student Intern)

Communities in our Study Area

Coal mine along Pennsylvania-West Virginia border to close

180 people will be laid off in August and September

Reid Frazier



7/30/2024

Unemployment Rate
(National Percentiles)

Less than 50 percentile

50 - 80 percentile

80 - 90 percentile

90 - 95 percentile

95 - 100 percentile

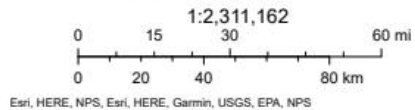
Data not available

Project 1

Project 2

Project 1

caprojectarea



- PA: ~ 2.3 million residents in AOI
- WV: ~ 600k residents in AOI
- negative health impacts
- low education
- earnings below federal poverty guidelines
- energy communities

Current Status and Accomplishments

- community benefits meetings
- DOE FPM meeting
- CAP team meeting
- Event

2024 Calendar

January 2024							February 2024							March 2024							April 2024						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6					1	2	3						1	2		1	2	3	4	5	6
7	8	9	10	11	12	13	4	5	6	7	8	9	10	3	4	5	6	7	8	9	7	8	9	10	11	12	13
14	15	16	17	18	19	20	11	12	13	14	15	16	17	10	11	12	13	14	15	16	14	15	16	17	18	19	20
21	22	23	24	25	26	27	18	19	20	21	22	23	24	17	18	19	20	21	22	23	21	22	23	24	25	26	27
28	29	30	31				25	26	27	28	29			24	25	26	27	28	29	30	28	29	30				
													31														

May 2024							June 2024							July 2024							August 2024						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4						1		1	2	3	4	5	6					1	2	3	
5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13	4	5	6	7	8	9	10
12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20	11	12	13	14	15	16	17
19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27	18	19	20	21	22	23	24
26	27	28	29	30	31		23	24	25	26	27	28	29	28	29	30	31				25	26	27	28	29	30	31
							30																				

Current Status and Accomplishments

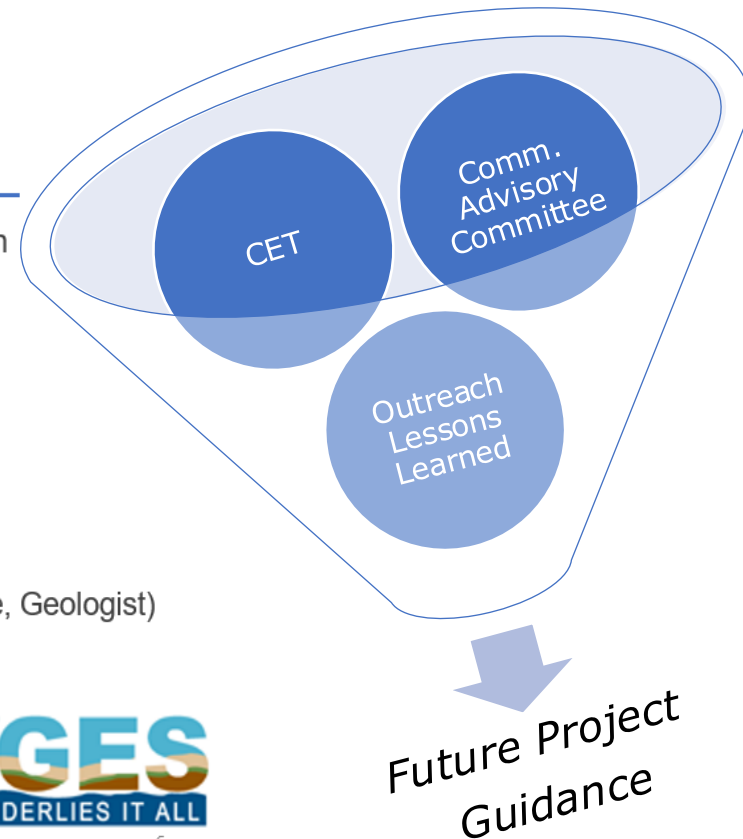
Task 2 Community Benefits

The Community Benefits Plan (CBP) goal is to conduct research, engagement and outreach to acquire information, begin building relationships, and start sharing accurate information on CCS to set future projects up for success.

Development of a Community Engagement Team and Community Advisory Committee

Project Partners and Resources

- The Community Benefits Plan team is led by Battelle in close partnership with Pennsylvania DNR and West Virginia GES
- **Joy Frank Collins** (Battelle, CBP Lead)
- Ivan Wehner (Battelle)
- Michele Cooney (PA DNR, Principal Investigator)
- Kristin Carter (PA DNR, Project Manager)
- Jessica Moore (WV GES, Project Manager)
- Support Team: Madison Urse, Callie Merz, Becca Blumer
- Advisory Committee: Storm Woods (Battelle DEI VP), Stuart Skopec (Battelle, Geologist) Jared Hawkins (Battelle, Geologist/J40)



Current Status and Accomplishments

Task 2 Community Benefits

Workflow and Tracking

Key	Red: Due this Month	Orange: Due next Month	OVERDUE	COMPLETED	Last Updated:	(dates based on 1/15/2024 start date)
GOAL	STEPS	DEADLINE	RESPONSIBILITY	COMPLETION DATE	NOTES	CBP COMPONENT
Track all interactions using Engagement Tracker	1. Set up Engagement Tracker	3/15/2024	IW	3/15/2024		C&LE
	2. Management of tracker and input procedures communicated	3/15/2024	IW, MC	3/15/2024		C&LE
	3. Back-fill should be completed	4/26/2024	MC, IW			C&LE
	4. Create Mailing List using tracker to distribute project info/web-blogsite updates, meeting invites, etc.	5/30/2024	IW			C&LE
Make initial contact with all community and stakeholders identified in the plan within (those who were not already contacted)	6. Make contact with all other community and stakeholders identified in the plan	5/1/2024	WV & PA			C&LE
	7. Follow-up to continue on regular basis based on project progress	7. Every 3 months or when something of note happens (can be having sent project e-newsletter or other correspondence)	WV & PA			C&LE
	8. Add to tracker	5/15/2024	WV & PA			C&LE
Follow-up with community and stakeholders already contacted with an update	8. Add to tracker and include previous contact dates	5/15/2024				C&LE
	9. Email, Phone call, letter, etc. to update on progress, thanks for support	5/15/2024			Instructions: Make initial contact with all community and stakeholders identified in the plan	C&LE
	10. Follow-up to continue on regular basis based on project progress	10. Every 3 months or when something of note happens (can be having sent project e-newsletter or other correspondence)				C&LE
Research workforce and Community Agreements already in place in the area, understand what they say, why they were created and the current relationship of parties involved	Research WV agreements	4/22/2024	MU		Due to the nature of the work, these won't be needed for this project, but our goal is to build a repository of information future projects can use	C&LE

Current Status and Accomplishments

Task 2 Community Benefits

Community and Labor Engagement

Engagement Groups

HBCUs, Colleges and Technical Programs: *Lincoln University*
Cheyney University
W&J

US Senators:
Robert P. Casey, Jr.
John Fetterman

State Agencies:
PADGS, PADCED, PADEP, WVDEC,
WVDEP, Governor's Office,

Operators:
CONSOL Energy

Municipalities:
Mayor's Office of Econ & Comm
Development, Charleston

CATF, Richard King Mellon Foundation, Carbon America, MRCI, multiple development authorities, MRCI, Coalfield Development, Appalachian Mt. Advocates, Friends of the Cheat, Osomono, LLC and many, many more...

"Pennsylvania authorizes regulation for carbon capture wells"

"Groups call for freeze on hydrogen hub talks over lack of transparency"

"Controversy on PA's new Carbon Capture & Storage Law"

Current Status and Accomplishments

A note...

ACT 87 Carbon Capture and Sequestration Act

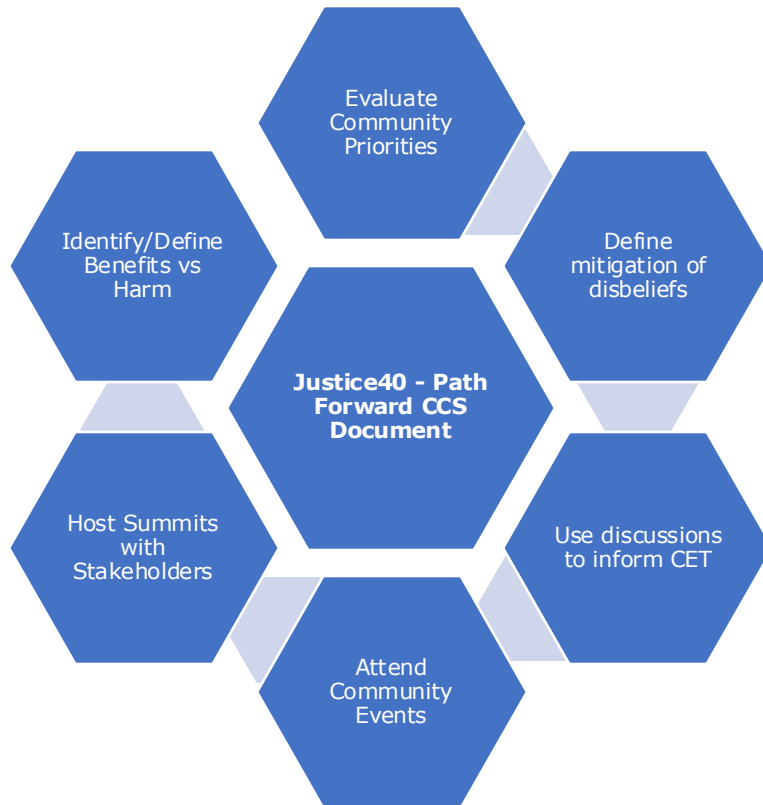
"An Act providing for the injection of carbon dioxide into an underground reservoir for the purpose of carbon sequestration, for the ownership of pore space in strata below surface lands and waters of the Commonwealth, for conveyance of the surface ownership of real property; imposing duties on the Department of Environmental Protection and the Environmental Hearing Board; and establishing the Carbon Dioxide Storage Facility Fund."

- Introduced as SB 831 by Senator Gene Yaw in June 2023
- Signed on July 17, 2024
- Provides a statutory framework for carbon capture and underground storage in Pennsylvania

Current Status and Accomplishments

Task 2 Community Benefits

Justice40 & DEIA



- Workforce Development/Job Training;
- Environmental Groups, EJ Groups, Community Health;
- Community Based Organizations;
- Utility Providers;
- Economic Development

Check out our banners!

Appalachian ENERGY

Past

Appalachia has a rich history of natural resource industries throughout the region. Appalachians coal has been a large contributor to energy supply in the United States for the last three centuries.

Coal used to be mined by digging and tunneling by miners using stone tools and labor fire.

Featured to the right, fondly referred to as "Vera", is a woman photographed in Fire Creek, West Virginia. Fire Creek is now a ghost town but was the location of one of the first coal camps established in New River Gorge, WV.

Present

Though coal is still mined throughout the region, natural gas is also widely produced in the Appalachian Basin.

West Virginia has 31 underground natural gas storage fields that can hold about 533 billion cubic ft. of natural gas which is 6% of the nation's total storage capacity (U.S. Energy Information Admin. [EIA]). An average American home uses about 196 cubic ft. of natural gas daily.

Future

The energy industry is constantly changing and developing. As the industry evolves different methods of exploration and mitigation for carbon capture and storage (CCS) are being explored.

This method separates CO₂ from other gasses, compressing and transporting it via pipeline, and finally injecting the CO₂ deep into rock formations for storage.

The stored CO₂ can be used in building materials, in manufacturing processes and for oil and gas recovery.

Project Goals

The Central Appalachian Partnership (CAP) for carbon storage aims to advance the deployment of carbon management throughout Pennsylvania and West Virginia. Reduction of barriers to carbon storage project opportunities is a goal of this project in addition to further research on carbon storage and how it interacts with communities as well as their environments.

Partners include the Pennsylvania Geological Survey (PAGS) and the West Virginia Geological & Economic Survey (WGES). Both of these organizations have expertise in respect to oil and gas, subsurface geology of the Appalachian Basin, and regional knowledge from two decades of regional characterization efforts with the Department of Energy (DOE) and Battelle. This was done to address gas and showcase the most relevant geologic and geospatial data sets to construct a free web-based tool with information about CO₂ storage efforts.

WGES ENERGY BATTELLE

Historical Photos APPALACHIAN ENERGY

Historical photos showing coal mining operations, including underground mines, surface mines, and coal processing facilities. The photos illustrate the evolution of coal mining from manual labor to mechanized operations.

WGES ENERGY BATTELLE

Current Status and Accomplishments

Task 2
Community
Benefits

DEIA & Workforce Development



New Summer Internship Program

- for students specifically from HBCU's/DACs
- geology and non-geology majors
- housing/transportation stipend
- work directly with Survey staff on CCUS-related projects

Outreach Events

Lincoln University Annual Science Fair (Nov '24)

CoSci (May '25)

ARC STEM Academies

ARC Annual Conference

County and Church Fairs

Community Meetings/Listening Sessions

*We'd love suggestions and collaboration
with other projects!*

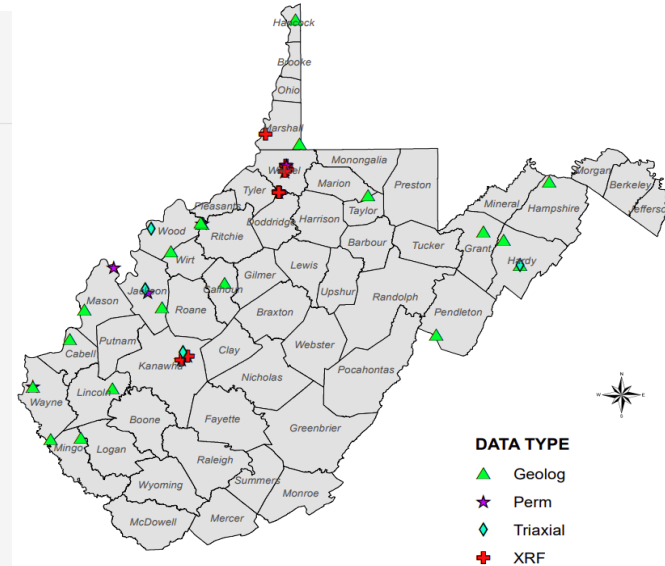
Current Status and Accomplishments

Task 3 Crosswalk & Model

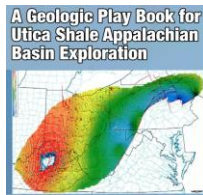
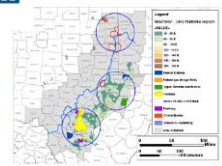
3.1 Data Crosswalk 3.2 Conceptual Geologic Model

GRP-Central Appalachian Partnership for Carbon Storage Deployment-DC...
Pennsylvania - Data Crosswalk ☆ ⓘ

Title	Year	Formatio...	Location	Data Type	Data Gap?	+ Add column
Downhole temperature data		multiple	PA	Temperatures	needs to be updated	
PA Core and Cuttings Holdings		Multiple	PA		YES	
Kostelnik and Carter, 2009	2009	Oriskany	Fayette Co, PA	Core, Petrographic, Petrophysical		
Top & Bottom Hole Locs for Greene, Wash, and Fayette Cos (2022)	2022	Multiple (Mostly Marcellus)	Greene, Washington, and Fayette Counties	Spreadsheet of Lat/Long	Needs to be updated	
Fayette Co Sample Studies as of 2023	2023	Multiple	Fayette Co, PA	Spreadsheet	Needs to be updated	
Marcellus Wells with 7+ years Production	2021	Marcellus	Pennsylvania	Spreadsheet of values		
Geologs with Vugs		multiple	Beaver and Fayette Co	Geolog	Needs to be updated	
CSTA Project 2009	2009	Upper Devonian sandstones, Salina Group, Medina Group, Gatesburg Fm	Pennsylvania	Report and maps		
Appalachian Storage Hub	2017	Multiple	WV, PA	Report and associated data files		
MRCSP Phase III - Enhanced Recovery Opportunities in the Appalachian Basin (in particular note Sections 5 and 6 re: organic-rich shale EGR and CCUS case studies, respectively)	2020	Devonian units	Appalachian Basin	report with tabular and map data		
MRCI Task 2.1 End BP 1 Report	2023	multiple	Appalachian Basin	Interim Report	will be replaced with final 2024 report later this year	
PA Basement Mapping	2022	Precambrian Basement	PA	Paper and GIS datasets		
MRCSP Petroleum Fields		variable depending on state/location	PA, WV+	geodatabase and Excel		
MRCSP MDMS Phase II Report	2009	multiple Middle Devonian through	Appalachian Basin	Report with tabular data and maps		



- DATA TYPE**
- ▲ Geolog
 - ★ Perm
 - ◆ Triaxial
 - ✝ XRF



Current Status and Accomplishments

Task 4 Data Acquisition

4.1 Data Gap Analysis 4.2 Laboratory Analysis



Sample Ranking

- Depth
- Average Porosity
- Thickness
- Permeability
- Pressure
- Proximity to sources
- Location of current/pending storage projects
- Transportation infrastructure
- Rock sample availability
- Potential for environmental impacts
- Potential for social impacts
- Other criteria as necessary

Porosity
Permeability
Geomechanics
Bulk Minerology
Clay Minerology
RVS
CT Scanning
Thermal Maturity

Field_Name	Pool depth	State	Net thickness	Average porosity	Permeability	Mode CO ₂ storage	Total rating
Walkchalk	6639	PA	0	0	0	0	8
Walkchalk	2967	PA	3	3	0	3	18
Waltersburg	9086	PA	0	0	0	0	8
Waltersburg	3408	PA	3	3	0	3	18
Warriors Point	5296	PA	0	0	0	0	7
Warriors Point	5580	PA	0	0	0	0	7
Washington-Taylorstown	10863	PA	0	0	0	0	7
Cameron-Garner	2797	WV	2	2	0	3	20
Cameron-Garner	6763	WV	3	2	0	2	18
Campbells Run-Miracle Run	2255	WV	1	3	0	2	16

Current Status and Accomplishments

Task 5 Web-Based Tool

5.1 State Specific Information 5.2 UIC Data for Class VI Permits

Permit Number	Permit Number - Old	DEP ID	Regulatory Status
37-059-00009-00-00	05900009		OTHER
37-059-00011-00-00	059-00011		Other
37-059-00016-00-00	059-00016		Other
37-059-00017-00-00	059-00017		Other
37-059-00018-00-00	05900018		

- ✓ *Direct measurement of reservoir and caprock properties*
- ✓ *Information regarding historical oil and gas wells*
- Geospatial inventory of rock core and cuttings samples
- Sample photographs and analytical results
- Location of all known oil and gas wells
- Links to downloadable documents for geocharacterization work

Required Item	Location in Application
GEOLOGIC NARRATIVE/SITE CHARACTERIZATION INFORMATION <i>The permit application will likely include a narrative description of the geologic structures, injection and confining zones, and fluid and solid geochemistry to meet the requirements of 40 CFR 146.82(a)(3), 5, and 6) and 146.83. The geologic narrative may be supported by maps, cross sections, and tabular data.</i>	
Regional Geologic Structure and Hydrogeologic Properties [40 CFR 146.82(a)(3)] <i>The description of the geologic structure and hydrogeologic properties of the proposed storage site and overlying formations must include the items below:</i>	
Maps and Cross Sections of the AOR [40 CFR 146.82(a)(3)(i)] <i>The maps and cross sections may be accompanied by a brief narrative description interpreting the figures and providing an overview of key features important to the project.</i>	GSDT Module/Folder: File Name: Page Number: Notes:
Information on Faults and Fractures [40 CFR 146.82(a)(3)(ii)] <i>This may be a narrative discussion of the location, orientation, and properties of known or suspected faults and fractures and a discussion supporting a determination that they would not interfere with containment. It may be accompanied by maps and cross sections and be supported by analyses of core samples, the results of geophysical surveys, pore pressure data, etc.</i>	GSDT Module/Folder: File Name: Page Number: Notes:
Data on the Injection Zone(s) [40 CFR 146.82(a)(3)(iii)] <i>This narrative may describe plans to collect or the results of geologic cores, outcrop data, seismic surveys, well logs, lithologic descriptions, and other field data used to characterize the injection zone(s), including geology/facies changes. The application must address the following types of data on the injection zone(s):</i> Depth, Areal extent, Thickness, Mineralogy, Porosity, Permeability, and Capillary pressure.	GSDT Module/Folder: File Name: Page Number: Notes:
Data on the Confining Zone(s) [40 CFR 146.82(a)(3)(iii)] <i>This narrative may describe plans to collect or the results of geologic cores, outcrop data, seismic surveys, well logs, lithologic descriptions, and other field data used to characterize the confining zone(s), including geology/facies changes. The application must address the following types of data on the confining zone(s):</i> Depth, Areal extent, Thickness, Mineralogy, Porosity, Permeability, and Capillary pressure.	GSDT Module/Folder: File Name: Page Number: Notes:



- Available geologic and engineering data for
- existing Class II wells
- Map products
- Digital datasets
- Lithology, thickness, extent
- Structure, faults and fractures
- Depth to groundwater
- Other supporting technical information

Thank You



Central Appalachian Partnership
for Carbon Storage Deployment

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