Findlay

Lima

Mansfield

Youngstown

Morgantowi

Staunton

State College

APPALACHIAN STORAGE HUB

Akron

Dayton

Field-Level Prospects Parkersburg Clarksburg Fairmont A Martinsburg M Winchester Gen

Cincinnati Kristin Carter, Assistant State Geologist Pennsylvania Geological Survey (Pittsburgh, PA)

> Huntington WEST Charleston VIRGINIA

Washing Dale City/

Chamber

Hagerst

WIHII ANT

Harrisonburg Fredericksbu

INTA 1

VIDC

PURPOSE OF THIS PRESENTATION

- Present three prospect areas within the AOI, each of which differs in number and type of opportunities
- Demonstrate how this Study's geologic data can be applied in underground storage siting work
- Stacked storage is important



GEOLOGIC INTERVALS OF INTEREST

System/Age	Interval	Description	Storage Type		
Mississippian	Greenbrier Limestone	Limestone comprised of multiple carbonate facies	Mined-rock cavern		
Lower Mississippian- Devonian	Keener to Berea	Multiple sandstones of variable location, thickness and extent	Depleted gas reservoirs		
Upper Devonian	Venango, Bradford and Elk groups	and Elk groups And Elk groups And Elk groups And Elk groups And extent And extent			
Lower Devonian	Oriskany Sandstone	Regionally persistent sandstone	Depleted gas reservoir		
Upper Silurian	Salina Group	Bedded salt formations	Salt cavern		
Upper Silurian	Newburg sandstone	Localized sandstone equivalent to Salina C interval	Depleted gas reservoir		
Lower Silurian	Clinton/Medina Group	Multiple sandstones of variable location, thickness and extent	Depleted gas reservoirs		
Lower Ordovician - Upper Cambrian	Rose Run-Gatesburg sandstones	Regionally persistent sandstone	Depleted gas reservoirs		

NORTHERN PROSPECT

- Oriskany Sandstone
- Salina F4 Salt (salt cavern)
- Clinton/Medina Group (depleted gas field)



NORTHERN PROSPECT



ORISKANY SANDSTONE



Structure Map (ft MSL)

Gross Thickness Map (ft)

ORISKANY SANDSTONE



ORISKANY SANDSTONE



SALINA F4 SALT





SALINA F4 SALT

Area 1 Cross Section



W

W-2

SALINA F4 SALT



F4 Salt

Area 2 Cross Section



CLINTON/MEDINA GROUP



Measured Depth (ft below ground surface)

• 4,100 - 6,300 ft deep

• 25 – 160 ft thick





CENTRAL PROSPECT

- Greenbrier Limestone (mined-rock cavern)
- Keener to Berea Interval (depleted gas fields)
- Upper Devonian Venango Group (natural gas storage field)
- Upper Devonian Elk Group (depleted gas field)
- Salina F4 Salt (salt cavern)



CENTRAL PROSPECT





- Optimal depth and thickness
- Large footprint
- Stacked opportunity
- Close to infrastructure
- Poor trap integrity
- Poor penetration rating









Condit-Ragtown Field Maple-Wadestown Field

Measured Depth (ft below ground surface)



- 1,988 2,595 ft measured depth
- ~800 1,000 psi reservoir pressure
- 17 170 ft net thickness
- 4% 18% porosity

UPPER DEVONIAN VENANGO GROUP



- Gantz sandstone
- 2,010 2,643 ft measured depth
- 1,000 psi reservoir pressure
- 10 20 ft net thickness
- 6% 13% porosity
- Racket-Newberne (Sinking Creek) Field

UPPER DEVONIAN ELK GROUP



Measured Depth (ft below ground surface)

UPPER DEVONIAN ELK GROUP



Net Thickness (ft)



- Benson siltstone
- 4,089 4,880 ft measured depth
- 1,900 psi reservoir pressure
- 2 66 ft net thickness
- 3% 20% porosity

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SOUTHERN PROSPECT

- Greenbrier Limestone
 (mined-rock caverns)
- Keener to Berea Interval (depleted gas field)
- Oriskany Sandstone (depleted gas and natural gas storage fields)
- Newburg sandstone (depleted gas fields)



SOUTHERN PROSPECT





- Optimal depth and thickness (up to 180 ft)
- Large footprint (combined ~700,000 ac)
- Stacked opportunities
- Close to infrastructure



• North-south: A - A'

- West-east: B B'
- West-east: C C'



Grainstone facies



Lime mudstone facies





Grainstone facies



Lime mudstone facies



Burdett-St. Albans Field (primarily Berea)

(ft below ground surface)



- 1,824– 2,510 ft measured depth
- 960 –1,000 psi reservoir pressure
- 4 27 ft net thickness
- 6% 20% porosity



Burdett-St. Albans Field (primarily Berea)

- Two North-south cross sections on eastern and eastern edges of field
- West-east cross section
 through middle of field







ORISKANY SANDSTONE (DEPLETED GAS FIELDS)



Elk-Poca (Sissonville) Field

Campbell Creek Field

ORISKANY SANDSTONE (DEPLETED GAS FIELDS)



Measured Depth (ft below ground surface)



Gross Thickness (ft)

ORISKANY SANDSTONE (DEPLETED GAS FIELDS)

ELK-POCA (SISSONVILLE) FIELD

- 4,140 5,497 ft measured depth
- ~2,200 psi reservoir pressure
- 2-102 ft gross thickness
- 18 ft net thickness
- ~4% -15% porosity

CAMPBELL CREEK FIELD

- 4,825 ft average measured depth
- 2,100 psi reservoir pressure
- 15 ft net thickness
- 9% porosity

THIN SECTION ANALYSES







DARRELL MATHENY #2 (WOOD COUNTY, WV)



Onondaga Limestone (caprock), 4197.1 ft (PL)

Oriskany Sandstone 4212.1 ft (PL): Note pore space



Oriskany Sandstone 4212.1 ft (XN): Note calcite cement



ORISKANY SANDSTONE (NATURAL GAS STORAGE)



Ripley Field

- Close to infrastructure
- 4,660 5,012 ft measured depth
- 15 56 ft net thickness
- Pay thicknesses of ~35 40 ft
- 2 9% porosity

NEWBURG SANDSTONE



NEWBURG SANDSTONE FIELDS

Field	Average producing depth (ft)	Net thickness (ft)	Average pay thickness (ft)*	Pressure (psi)	Porosity (%)	Permeability (mD)*	Initial pressure (psi)	Trap type
North Ripley	5,379	77	7	2,300	14.0		2,329	Stratigraphic/ Structural
Rocky Fork	5,623	140	5	2,400	18.0	46	2,435	Stratigraphic/ Structural
Cooper Creek	5,754	30	6	2,500	15.0		2,491	Stratigraphic/ Structural
Kanawha Forest	5,378	48	8	2,300	11.0	14	2,329	Structural

*from Patchen (1996)

NEWBURG SANDSTONE FIELDS

North Ripley Field





- 5,010 5,780 ft measured depth
- 2,300 psi reservoir pressure
- 7 ft average pay thickness
- 14% porosity

NEWBURG SANDSTONE – NORTH RIPLEY FIELD



NEWBURG SANDSTONE FIELDS

Rocky Fork Field

Cooper Creek Field





- 5,220 6,150 ft average producing depths
- 2,400 2,500 psi reservoir pressure
- 5 6 ft average pay thickness
- 15% 18% porosity

NEWBURG SANDSTONE – ROCKY FORK AND COOPER CREEK FIELDS



NEWBURG SANDSTONE FIELDS

Kanawha Forest Field





- 4,940 5,940 ft average producing depths
- 2,300 psi reservoir pressure
- 8 ft average pay thickness
- 11% porosity

NEWBURG SANDSTONE – KANAWHA FOREST FIELD



SUMMARY

- Presented three prospects along the Ohio River Valley corridor
- Provided an example of how end users may apply the regional and field-level data prepared for this Study in their own underground storage considerations
- Demonstrated the importance of stacked opportunities

