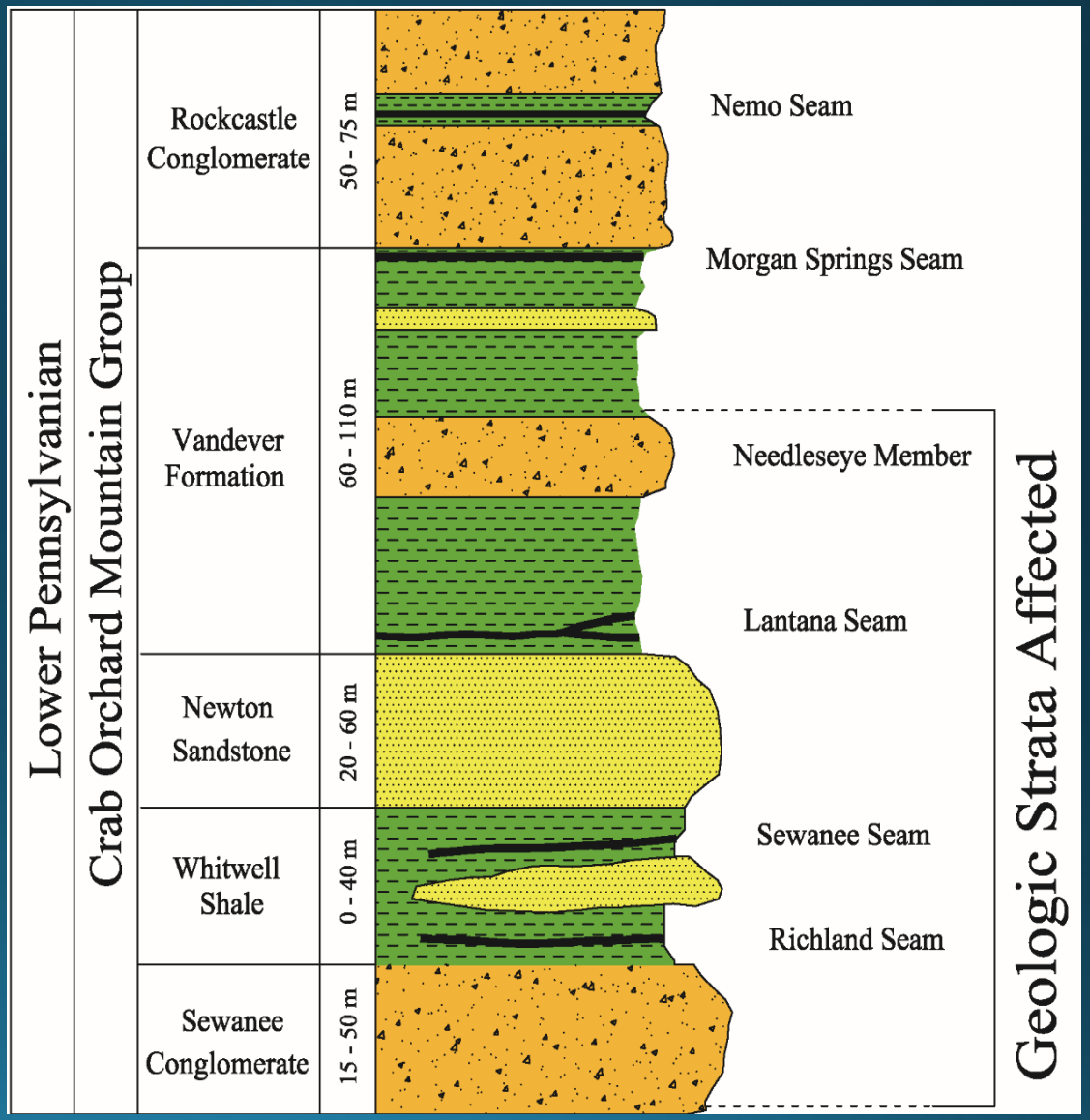
Crossville Coal Passive Treatment System

Redesign of a non-functioning iron and manganese treatment system

Rick Mann, PG, OSMRE LFO
Adam Ramsey, PE, OSMRE LFO
Wesley Smith, PG, OSMRE LFO

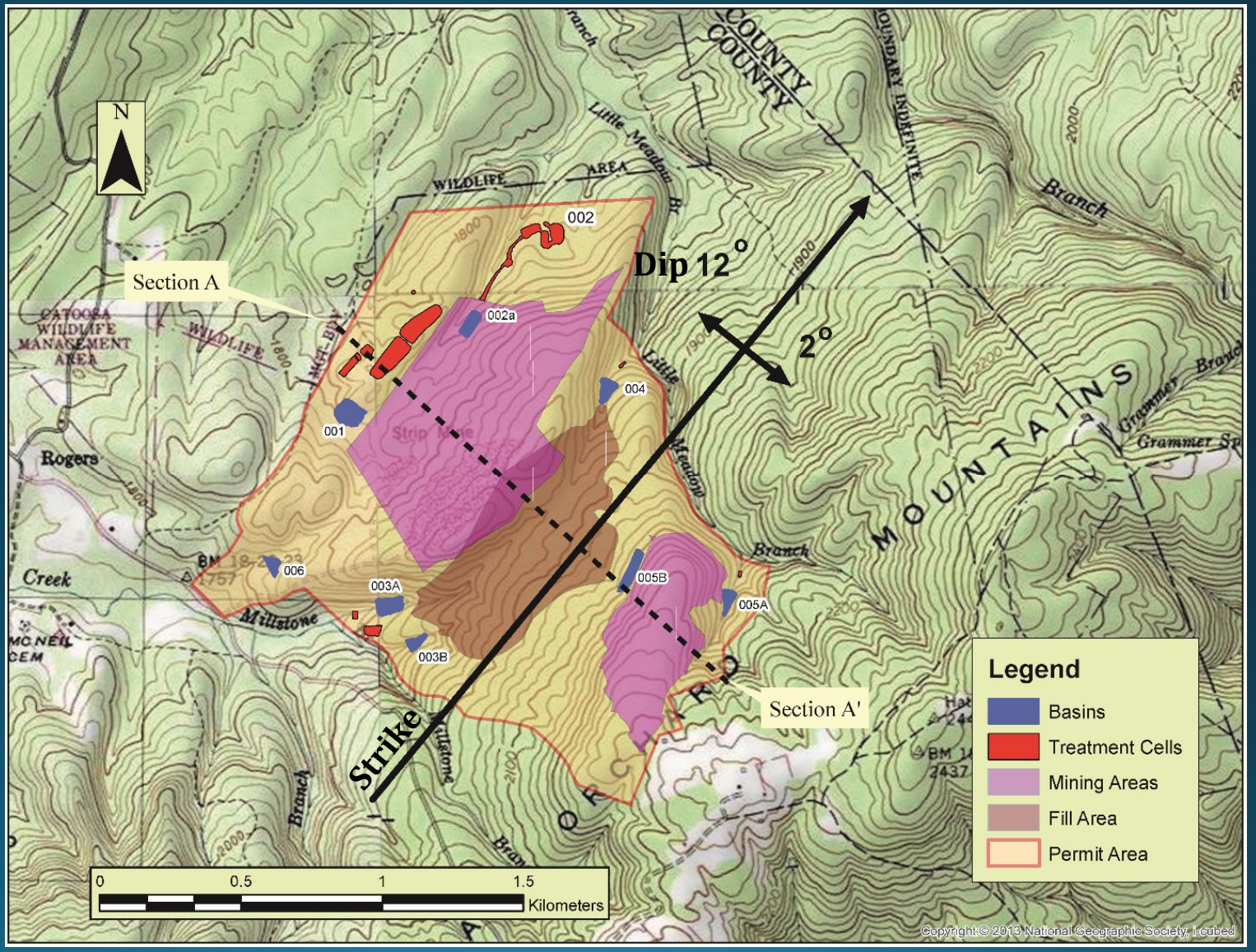
Crossville Coal

- Originally permitted under the TN Interim program in 1980.
- Permitted by OSMRE in 1997.
- Targeted the Sewanee Coal Seam.
- Elevated Mn concentrations identified in 2005.
- Larsen et al. found source of the Mn was siderite concretions and cements primarily in the Whitwell Shale.



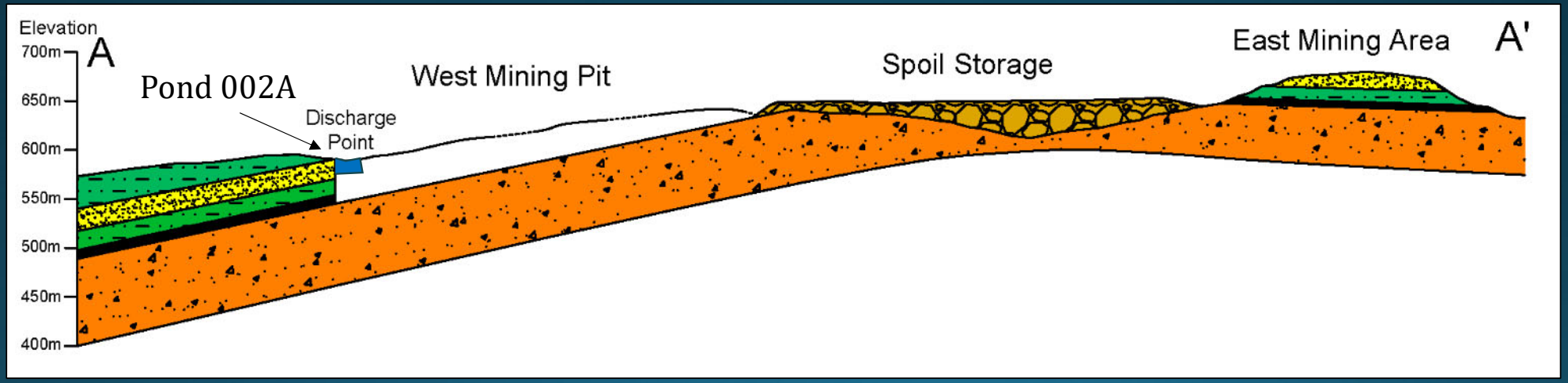
Sequatchie Valley Anticline

- West mining pit discharges along the low wall of the reclaimed pit.
- Pond 002A was built over the reclaimed pit.



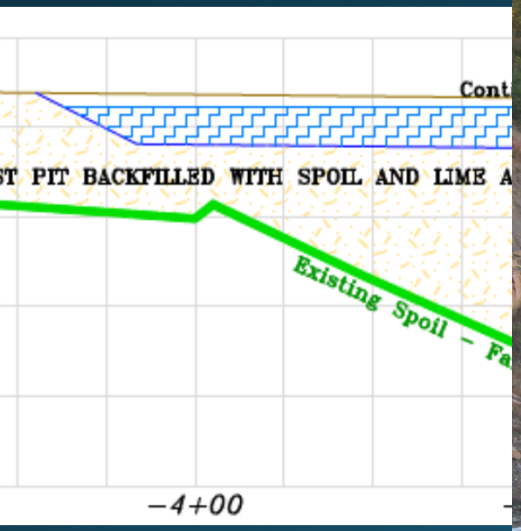
Sequatchie Valley Anticline

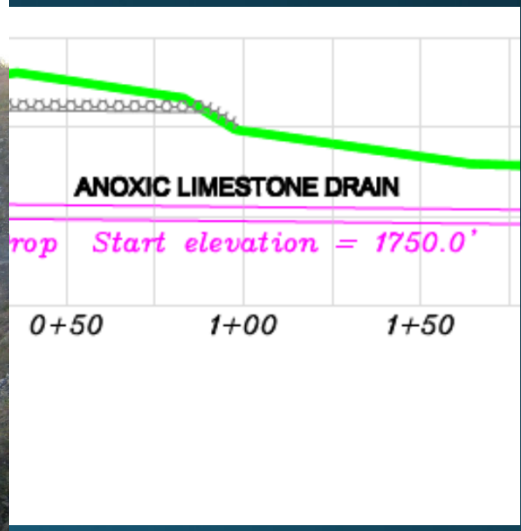
- Folding and faulting resulted in a coal thickness which varied from 0.5 feet to 40 feet (0.15 m to 12 m)




2009

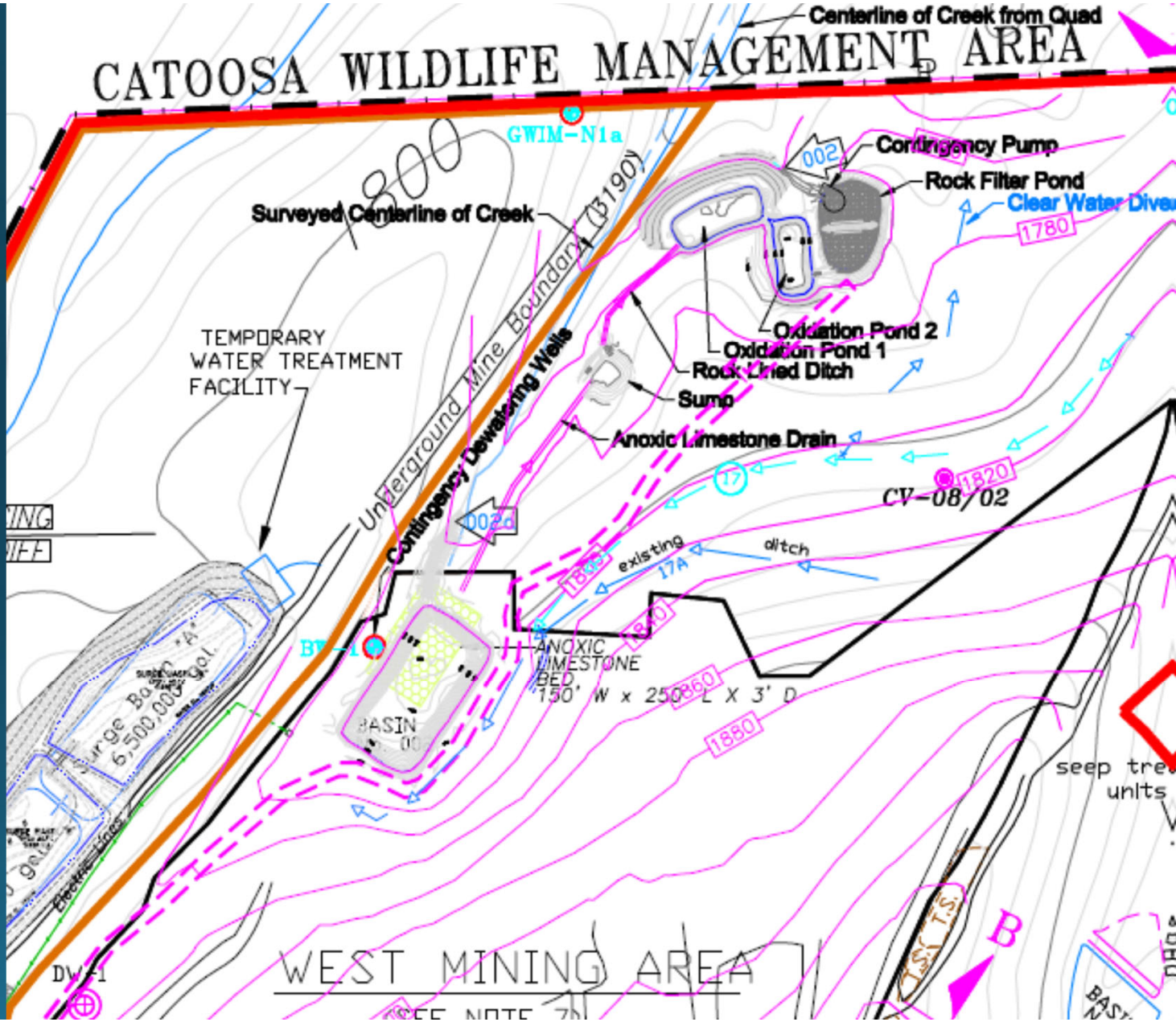
Previous Treatment System





Previous Treatment System

- Completed in 2014
- Started failing 1 year after completion.



Conditions inherited by OSMRE at bond forfeiture

Artesian discharge from chimney drain due to plugged ALD.

- DO <1 mg/L
- pH 6.20
- Alkalinity 50 mg/L
- Fe 30 mg/L
- Mn 18 mg/L

Conditions inherited by OSMRE at bond forfeiture

- Iron precipitate had coated rock in the manganese bed.
- Non-complaint discharges.
- Nonfunctioning Mn bed.
- Extensive pump back and chemical treatment system (non-working).

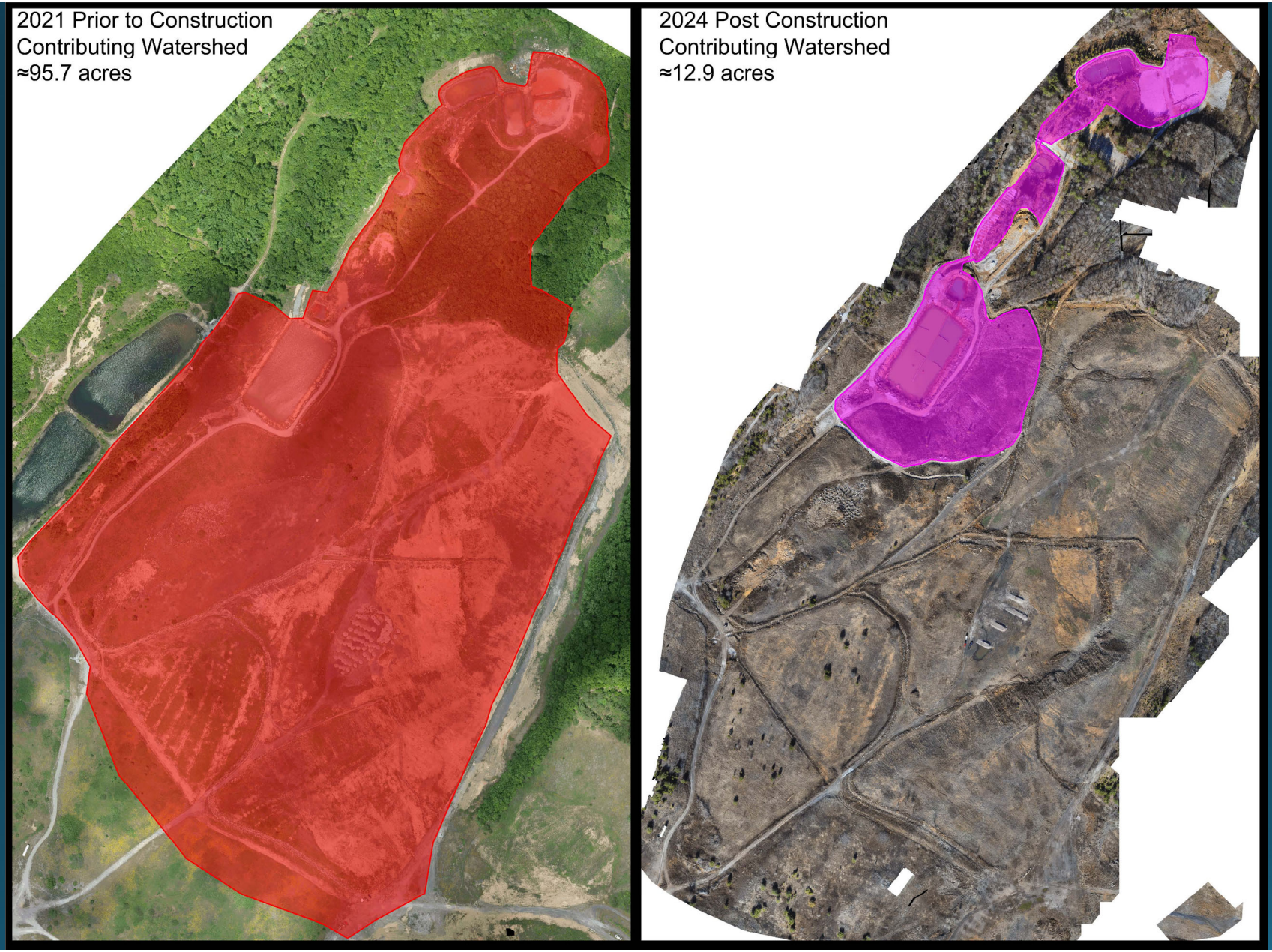
Conditions inherited by OSMRE at bond forfeiture

- ALD excavated and plugged.
- Iron precipitate found in ALD.

OSMRE Objectives

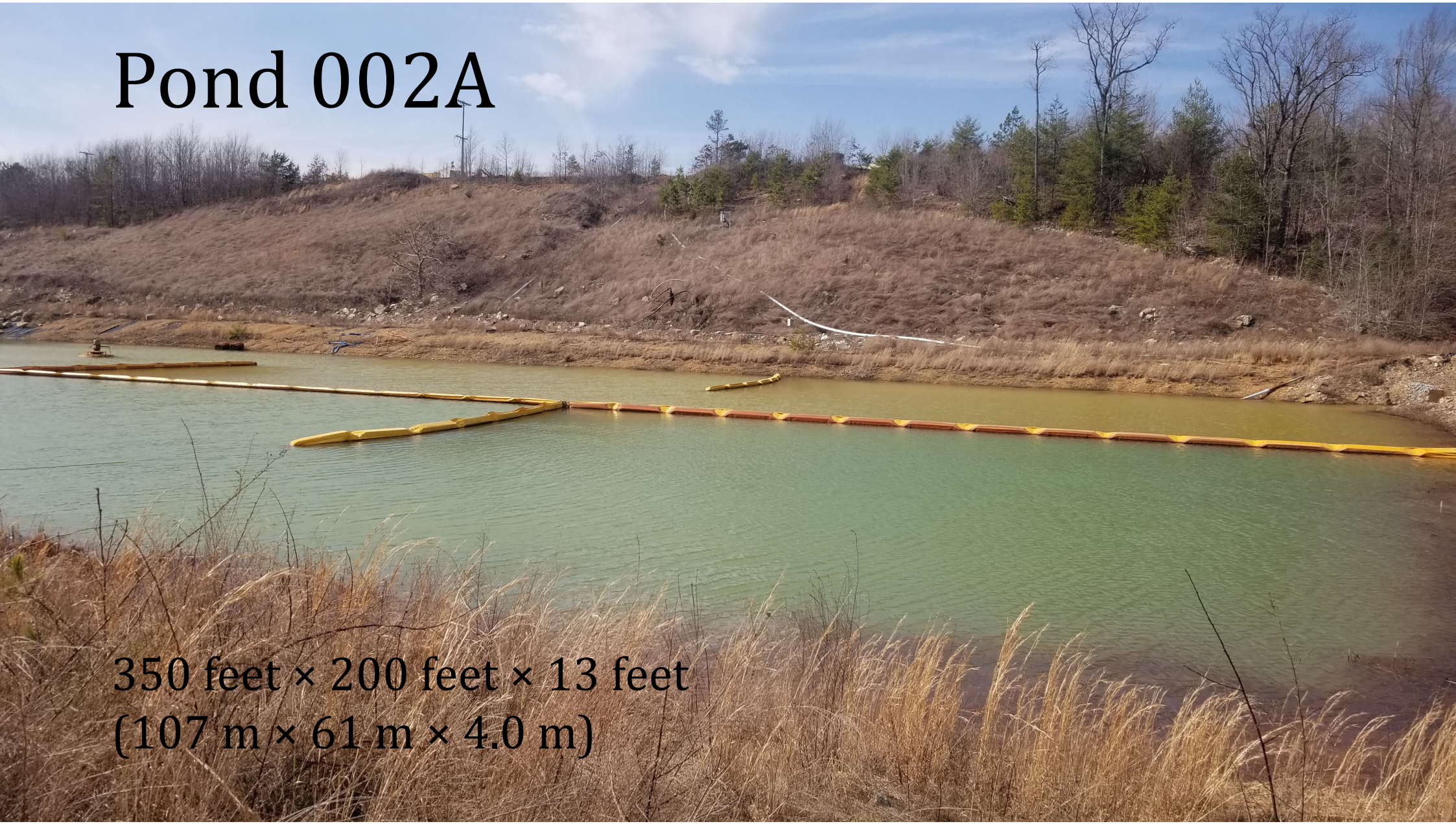
- Goals
  - Eliminate pumping and the need for electricity.
  - Eliminate chemical treatment.
  - Increase retention time.
  - Reduce infiltration.
  - Minimize surface water entering the system.
  - Passive system with minimal maintenance.
- Problems
  - Low DO
  - Minimal drop to aerate.
  - Shallow bedrock
  - Poor flow quantification
  - Large surface and groundwater sources entering treatment system.
  - Non-working and cost prohibitive treatment system.

- Flow
  - Average flow of 219 gpm (829 L/min)
  - Flows as high as 1,276 gpm (4,830 L/min) observed after precipitation


2021 Prior to Construction
Contributing Watershed
≈95.7 acres
2024 Post Construction
Contributing Watershed
≈12.9 acres

Raw Water Pond

- Raw water pond embankment was constructed on top of the low wall.
- Groundwater from the chimney drain now discharges into the raw water pond.
- Isolate the groundwater to consolidate discharge to a single point.


Pond 002A
350 feet × 200 feet × 13 feet
(107 m × 61 m × 4.0 m)

Pond 002A Water Level Control Structure

- Two 6” valves (15.24 cm) control the flow from Pond 002A.
- 4.5 Ac-ft storage (5,550 m^3) to buffer storm flows.
- Valves set at 250 GPM (946 lt/m)
- Also allows flow to be temporarily cut off while doing treatment system maintenance.
- 12-15 years of sludge storage.

Lazy River

- Railroad ties and recycled rock were used to create a shallow serpentine ditch for aeriation.
- 280 feet long, 28 baffles
- Primarily to degas CO_2 and introduce oxygen.

Mn Bed #1

Mn Bed #2

- Header pipe to distribute flow.
- (6) 6” (15.24 cm) valves with shut-off valves.
- AASHTO#3 Stone
- Also allows flow to be cut off if Mn Bed #1 stone needs to be cleaned.


pH 6.85
Fe 1.42 mg/L
Mn 12.90 mg/L
0
125
250
500 Feet

Location	pH	Specific Conductance	Total Iron	Total Manganese
		µS/cm	mg/L	mg/L
Raw Water Sump	6.29	1040	25.00	18.10
Pond 02A Spillway	6.53	1001	3.10	17.30
End of Sinuous Ditch	7.02	985	1.38	7.12
Settling Pond Spillway	6.84	1003	0.45	4.76
Mn Bed #1 Spillway	7.18	1050	0.23	<0.04
Outfall	7.61	1059	0.13	<0.04

Low Flow
(131 gpm / 496 lt/min)

Location	pH	Specific Conductance	Total Iron	Total Manganese
		µS/cm	mg/L	mg/L
Raw Water Sump	6.81	1370	24.20	17.20
Pond 02A Spillway	6.48	1180	7.00	15.40
End of Sinuous Ditch	6.82	1174	1.72	13.60
Settling Pond Spillway	6.76	1131	1.28	13.00
Mn Bed #1 Spillway	7.40	1188	<0.05	0.37
Outfall	7.92	1171	<0.05	<0.01

High Flow
(284 gpm / 1,075 lt/min)

Summary

- Eliminated pumping, electricity and chemicals.
- Diverted approximately 83 acres from draining to the treatment system watershed.
- System has been designed for minimal maintenance and to be much more maintenance friendly.
- Cost savings of at least $50,000 per month.
- Additional ditch work is planned to increase aeration.
- Cover the site with trees to help reduce infiltration through the spoil.
- Now discharging compliant water through all conditions.

Questions?