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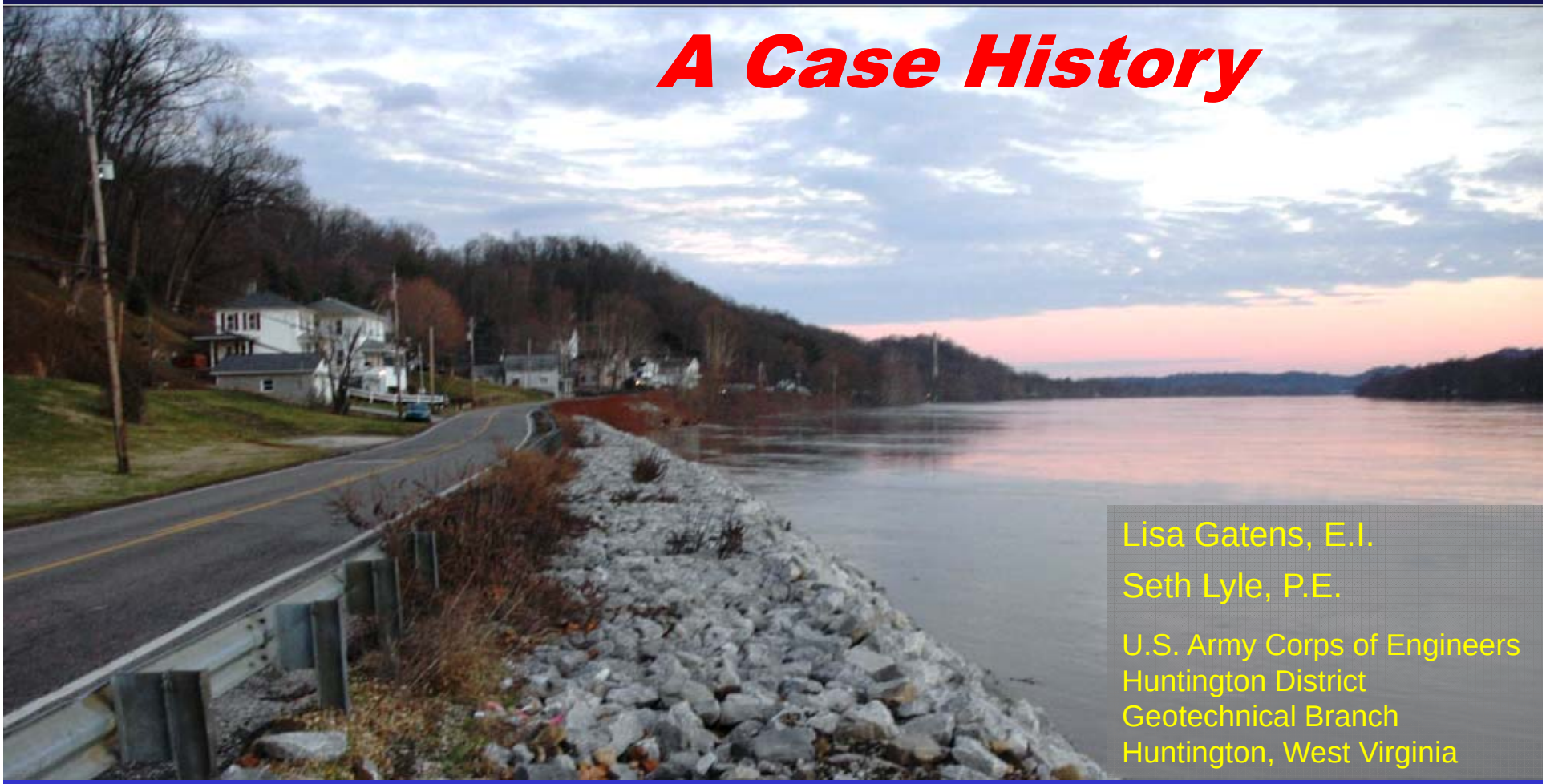
Minersville, Ohio Riverbank Stabilization

A Case History



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Huntington District
Geotechnical Branch
Huntington, West Virginia

One Team—Relevant, Ready, Responsive, Reliable

Presentation Outline

1. **Background**
2. **Challenges**
3. **Investigations**
4. **Remedial Measures**
5. **Summary**
6. **Recommendations**
7. **Questions**

WHAT?

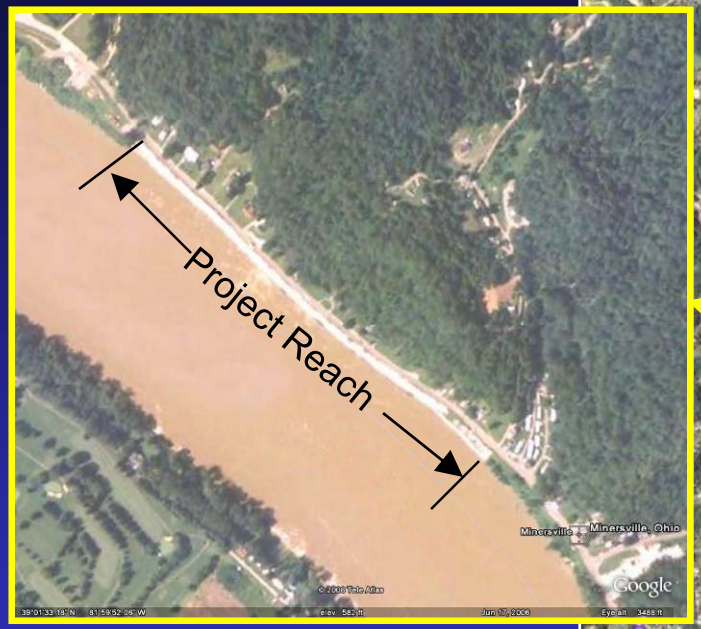
Section 14 of the 1946 Flood Control Act (Public Law 79-526)

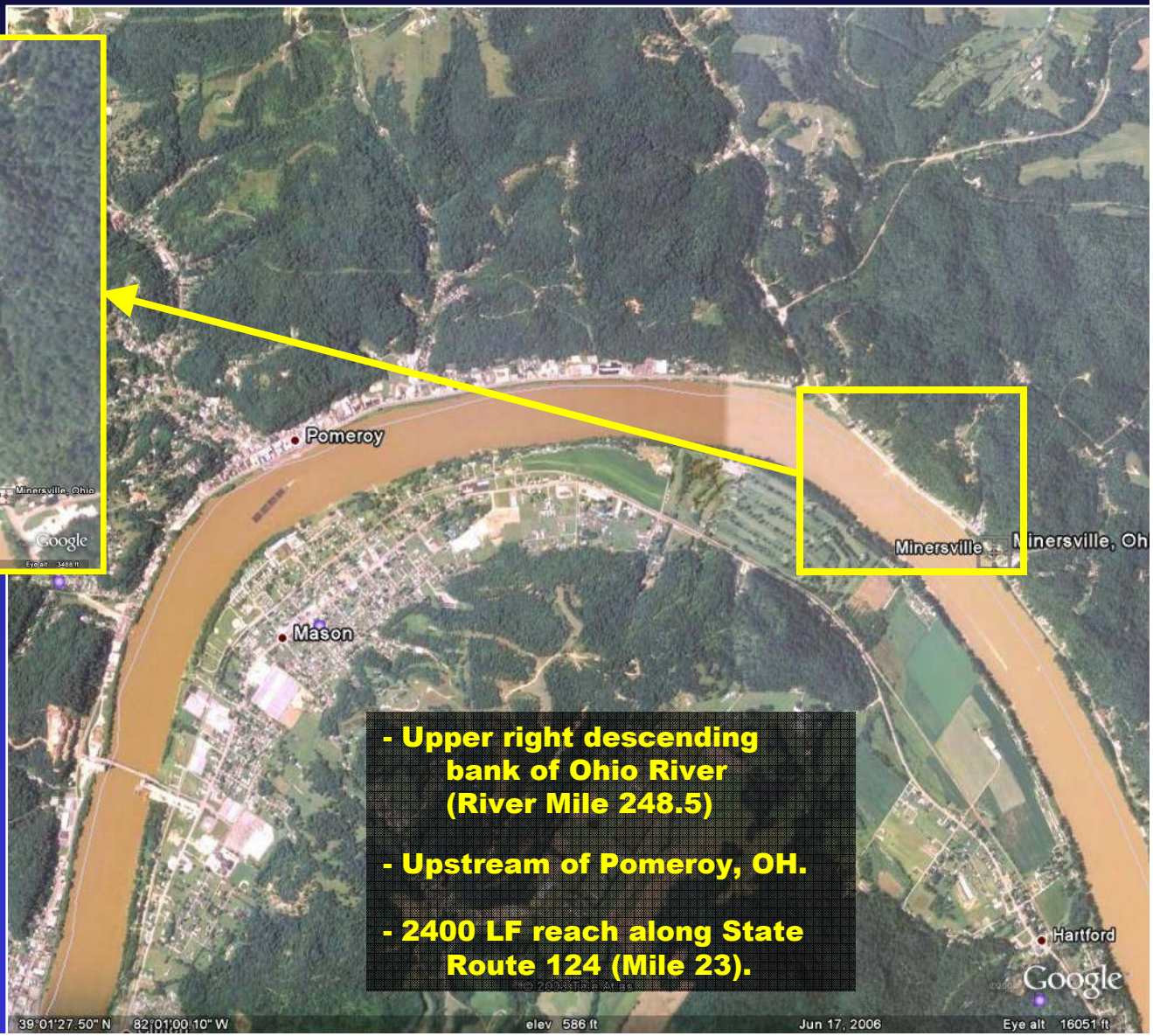
- Authority for USACE to plan and construct flood damage related emergency streambank and shoreline protection projects.
- Critically essential public facilities (highways, sewer lines, schools, etc.)
- Federal costs limited to $1.5M for each project.
- Projects accepted after an investigation of relocation alternatives, engineering feasibility, environmental acceptability, and economic justification.

WHO?

- **USACE (federal goverment)**
- **ODOT (non-federal sponsor)**
  - **First $100K of study funds are 100% federally funded.**
  - **Remainder is 65% federally funded and 35% sponsor funded, not to exceed $1.5M.**

WHERE?





- Upper right descending bank of Ohio River (River Mile 248.5)
- Upstream of Pomeroy, OH.
- 2400 LF reach along State Route 124 (Mile 23).

WHY?

Constructed to address retaining wall collapse, top-of-bank retreat, and related roadway failures.

WHEN?

Construction commenced in September 2003 and was completed in October 2004.

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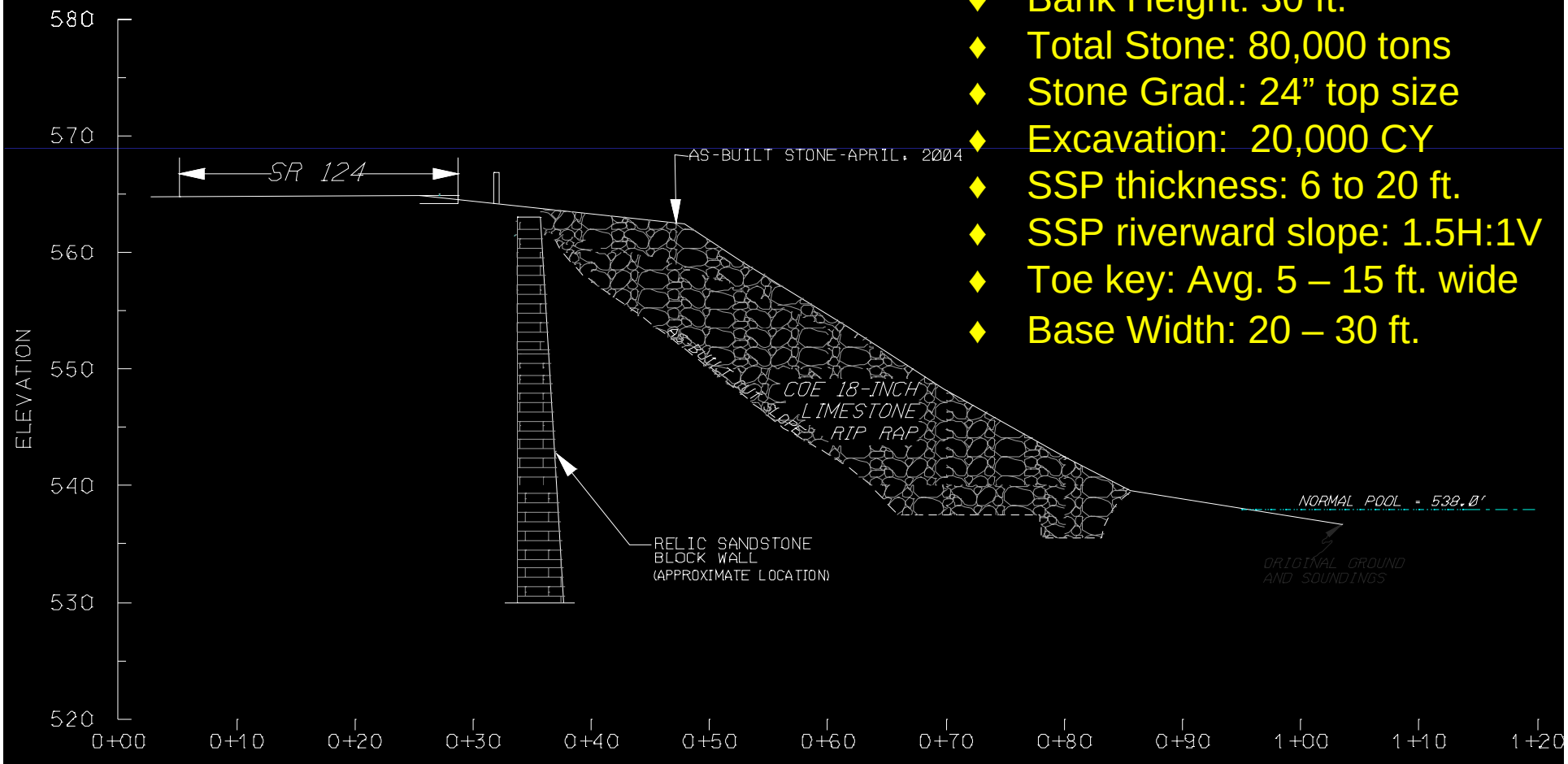
Project Specifics

- Total Cost: $2.5 M
- Length: 2400 ft.
- Bank Height: 30 ft.
- Total Stone: 80,000 tons
- Stone Grad.: 24” top size
- Excavation: 20,000 CY
- SSP thickness: 6 to 20 ft.
- SSP riverward slope: 1.5H:1V
- Toe key: Avg. 5 – 15 ft. wide
- Base Width: 20 – 30 ft.



STATION 14+75

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Ohio River Railway

Railway car system extended 12 miles along the Ohio River . Built in 1900.

Photo from downtown Pomeroy, Ohio

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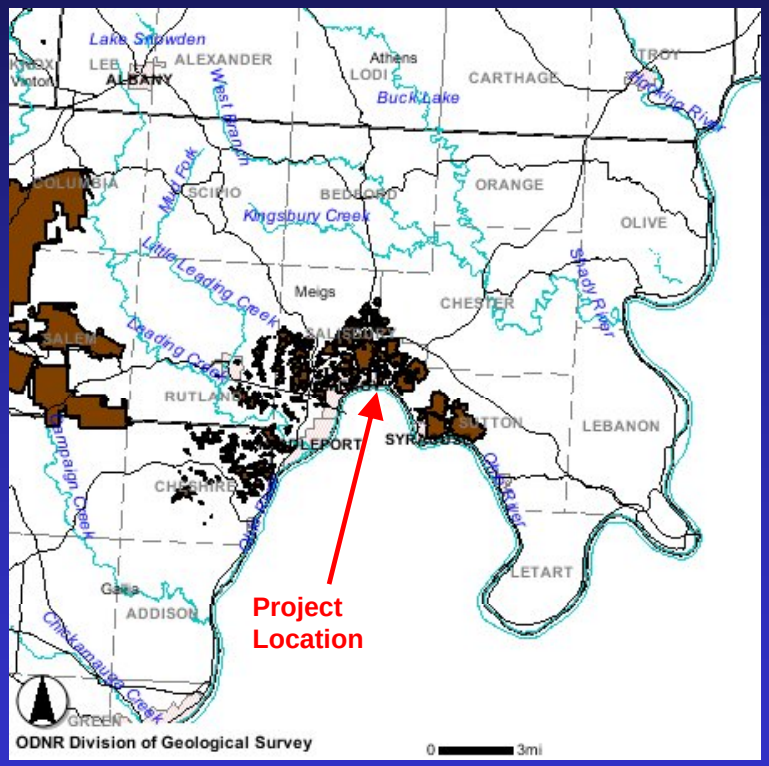
Abandoned Coal Mines

Overview of Abandoned Underground Coal Mines, Meigs County, Ohio

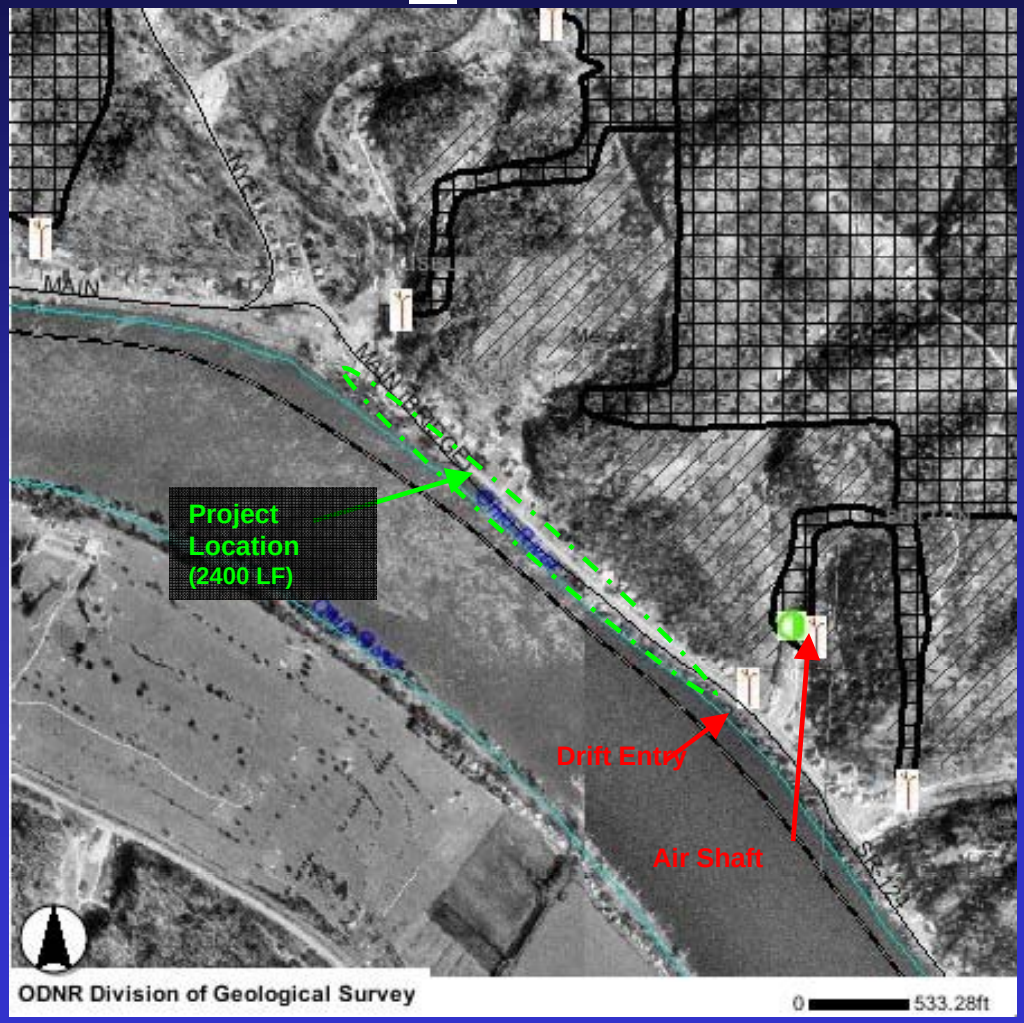


More than 40,000 acres of abandoned underground coal mines located up dip of project. 14 separate mines. Some sealed during the WPA days.

Abandoned Underground Mines, Minersville, OH

= underground mines

= underground mine extent partially unknown



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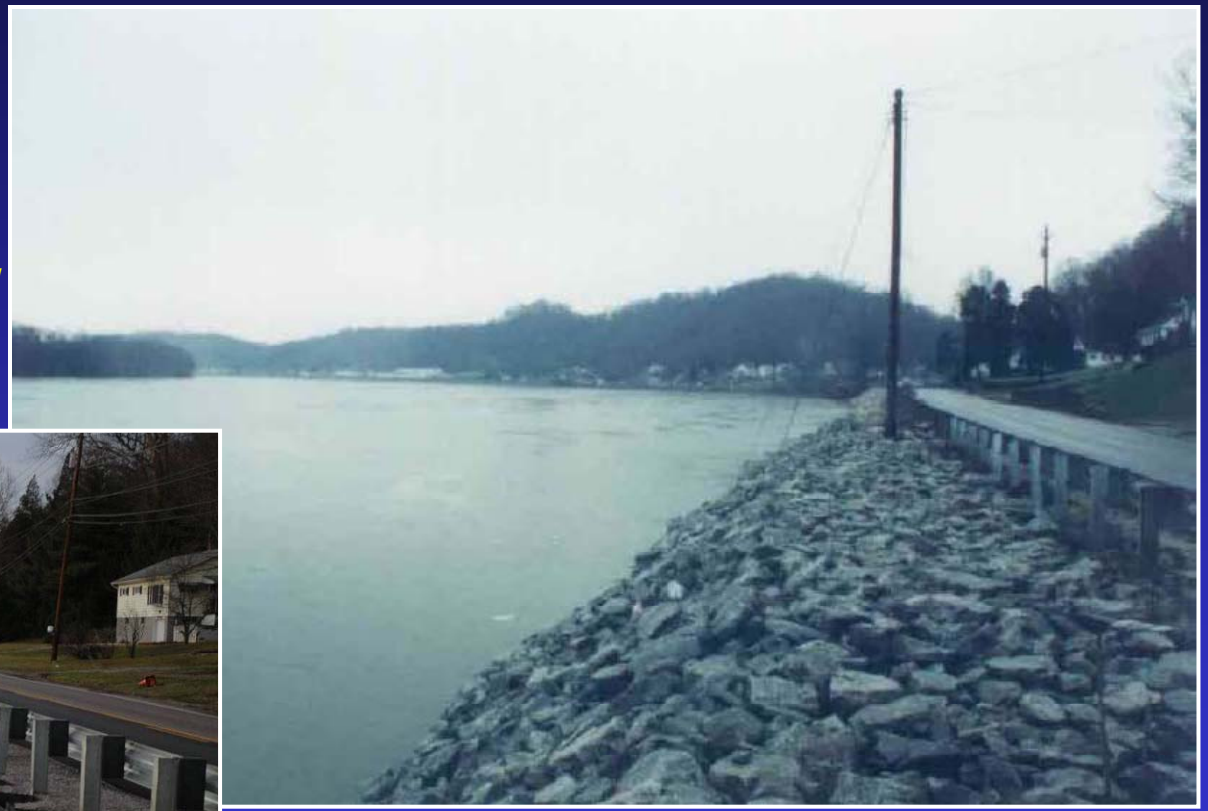
Abandoned Coal Mines & Related Drainage

- Relic drainage features noted landward of project reach.
- Collapsed vault structure noted on landward side of SR 124 in displaced reach.
- Cross drains through roadway were not functional.

Construction Challenges

- Seven Ohio River flood events inundated the roadway during construction.
- Barges got loose from tow and ran up on roadway damaging shoulder.



Displaced Reach

Investigations

- **Post construction surveys**

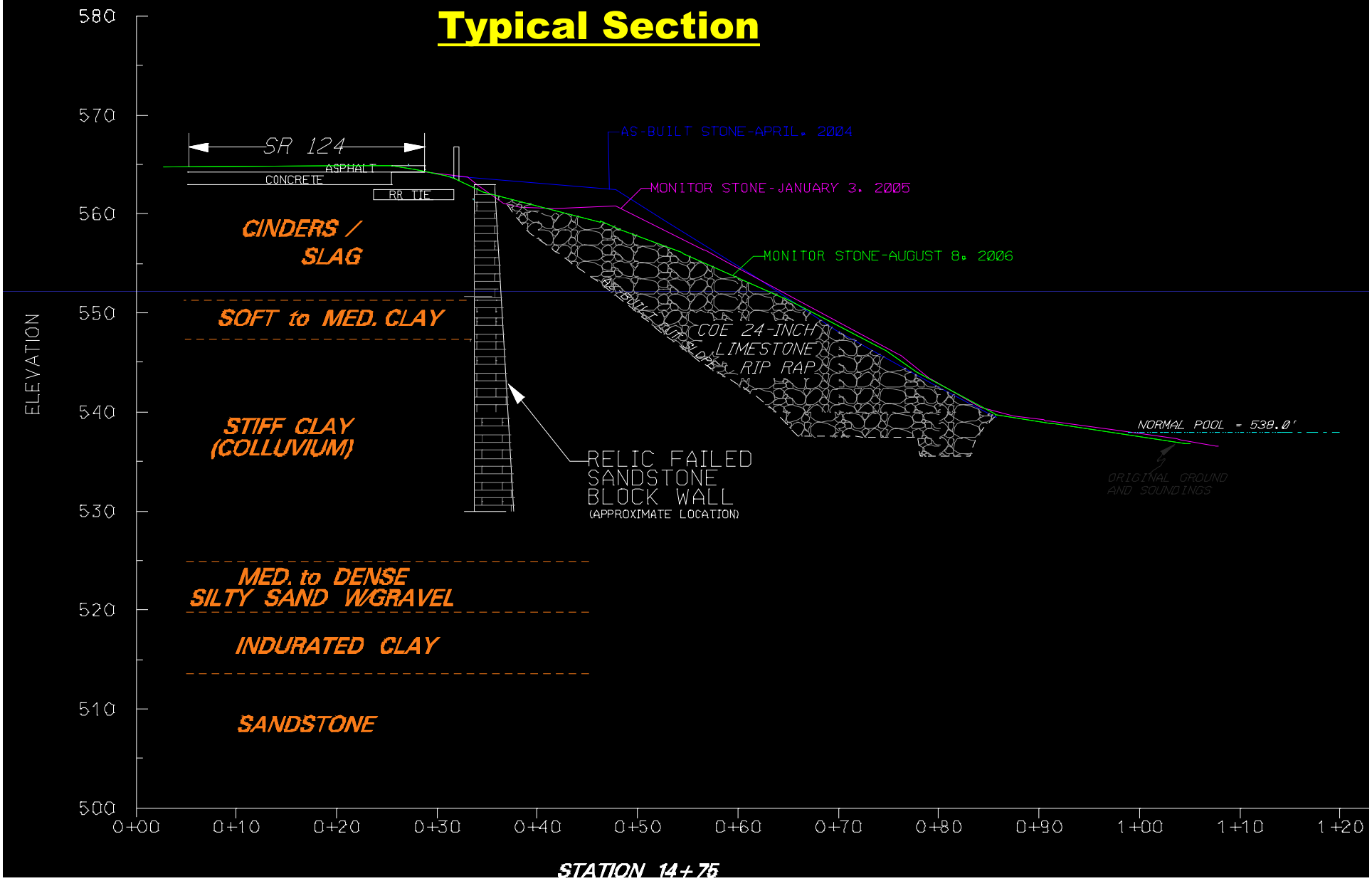
  - As-Built (April 2004)
  - 10 June 2004
  - 15 June 2004
  - 16 July 2004
  - 3 Jan. 2005
  - 8 Aug. 2006

- **ODOT borings (Nov. 04)**
- **USACE borings (July 06)**
- **Bathymetric surveys (2002 and July 2006)**

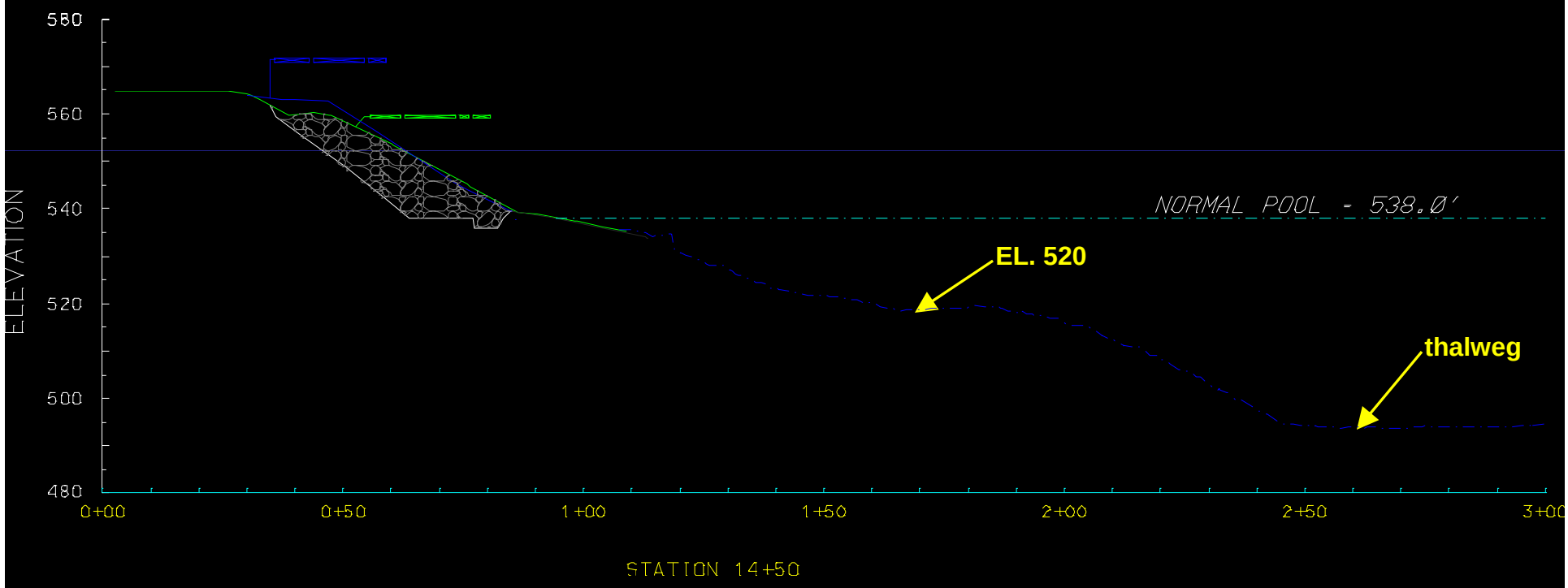
  (Note: 2002 bathymetric survey data limited; sections taken every 500' along river; only one x-section within study reach at approx. Sta. 15+60)

- **Review of Historic Mapping**

Typical Section



Section including July 2006 Bathymetric Survey



- Survey sections at 25 to 50 ft. increments from station 12+50 to 17+00.
- Bathymetric survey performed at same sections as bank sections and at upstream and downstream limits of project, as well as parallel to bank for length of project.

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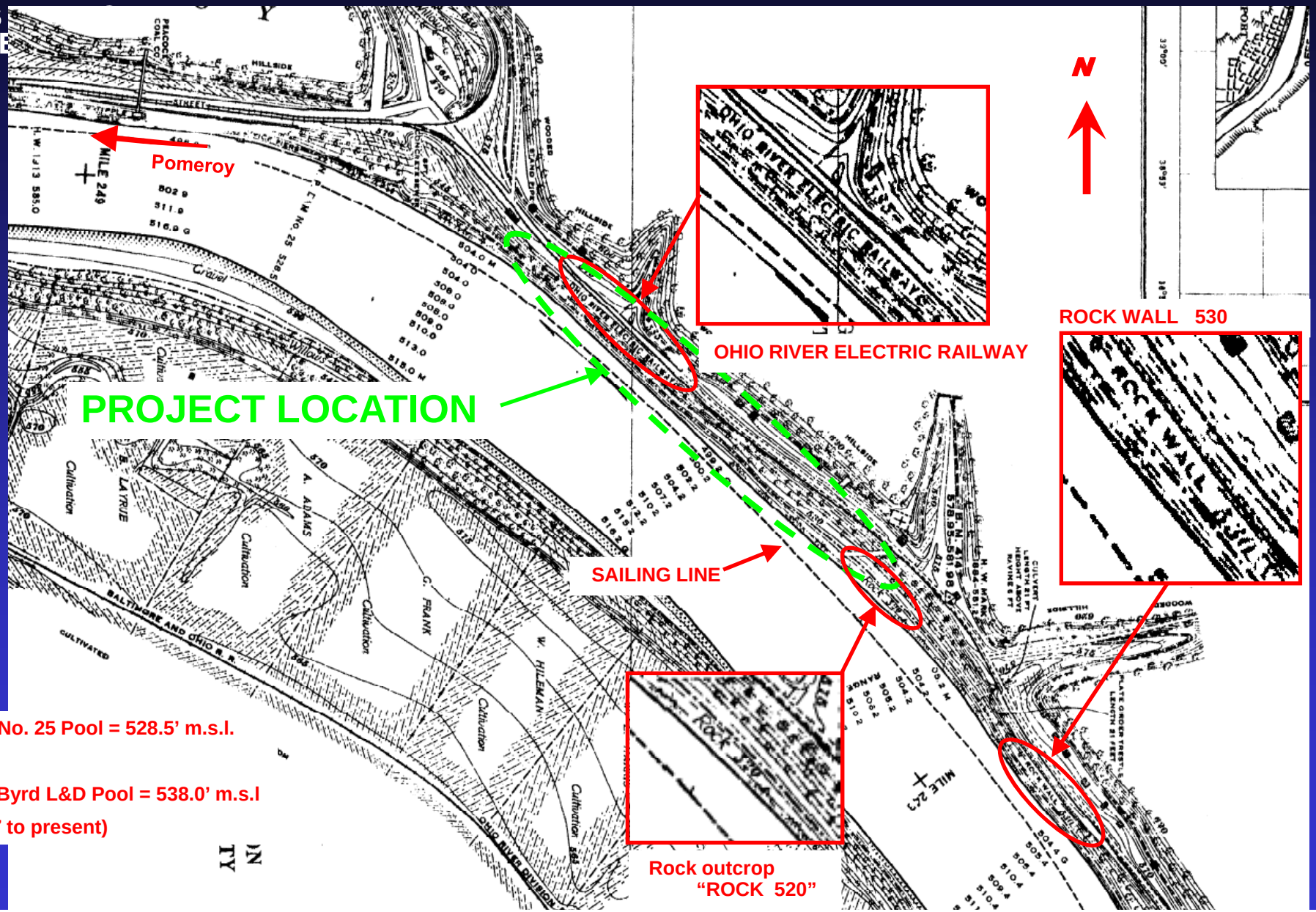
1911-1914 Ohio River Survey

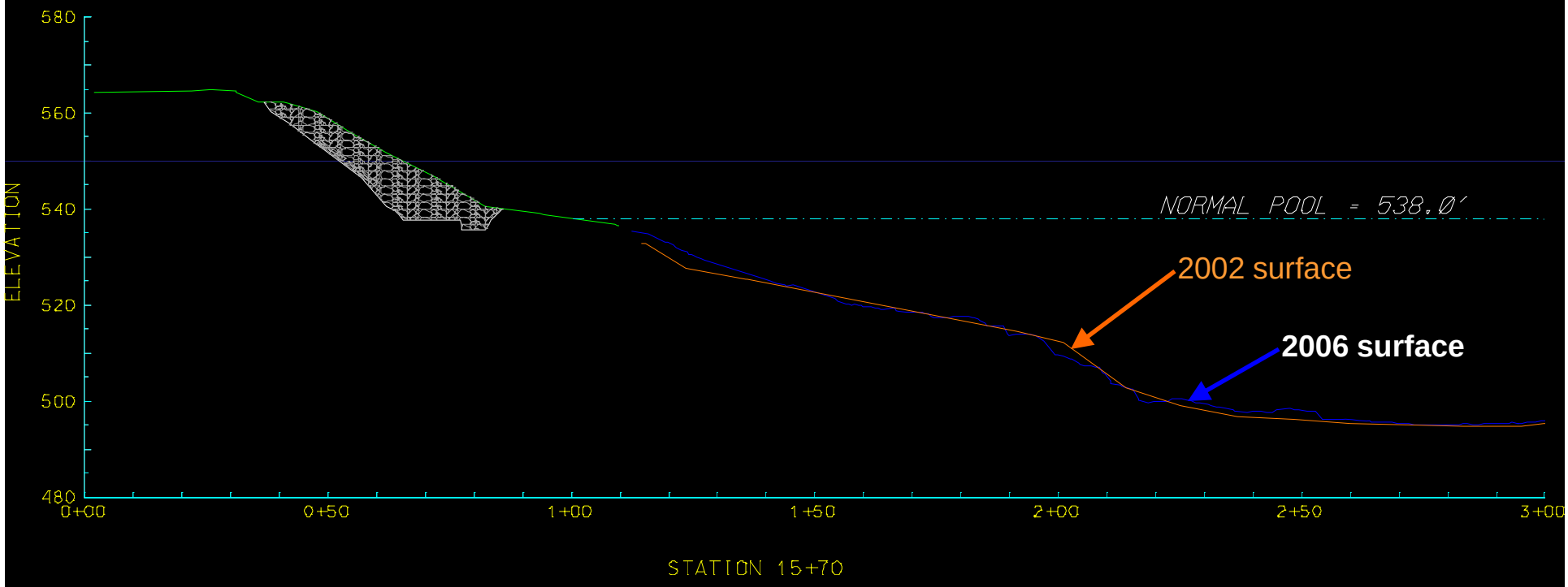


L&D No. 25 Pool = 528.5' m.s.l.

R.C. Byrd L&D Pool = 538.0' m.s.l
(1937 to present)

Pre (2002) vs. Post (2006) Construction

Bathymetric Surfaces Sta. 15+70



- 2002 survey sections performed in 500 ft. increments along entire reach of RCB L&D pool.
- Survey sections within project reach are located at approximately Sta. 4+50, 10+00, 15+70, and 21+50.

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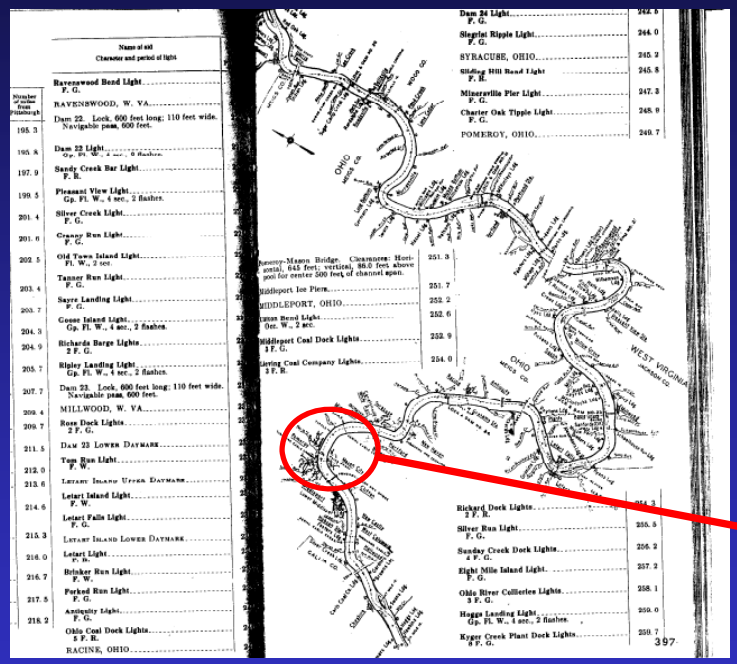
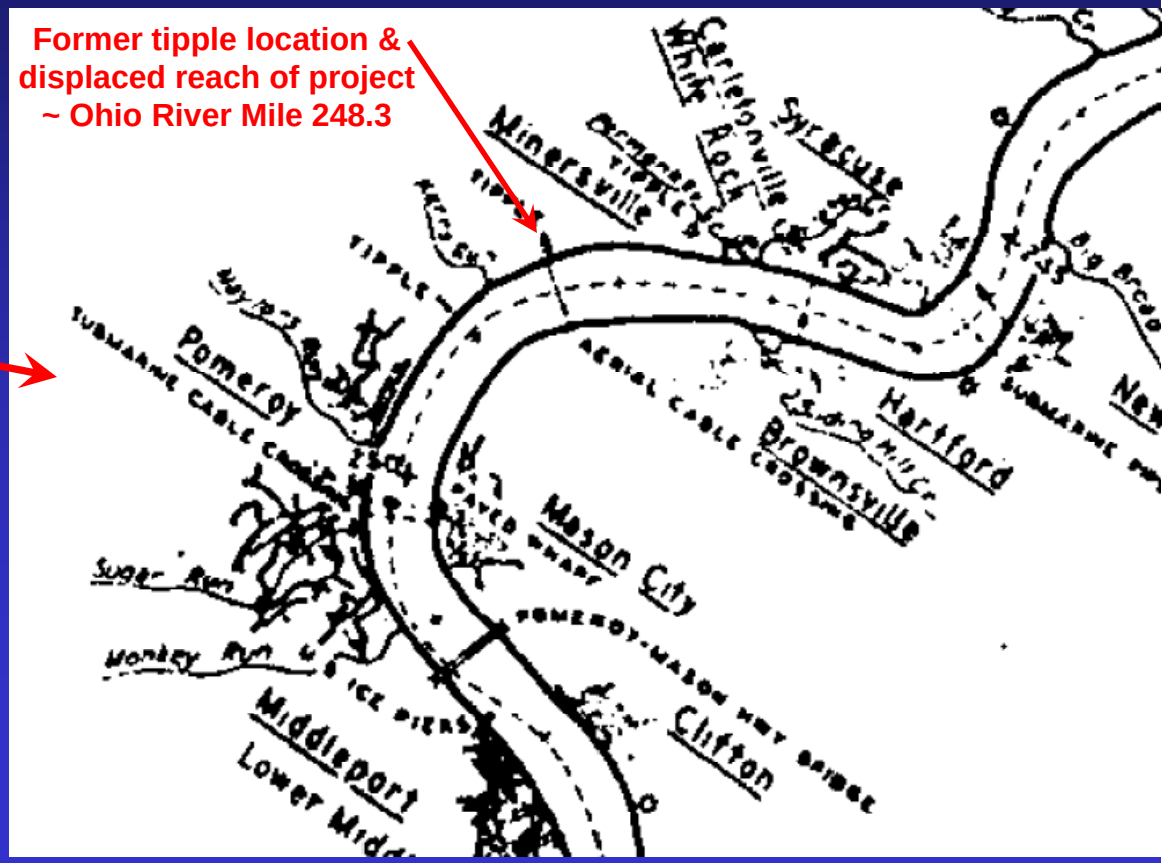
Former Tipple Location in Project Reach



1935 Ohio River Navigation Chart



-Note:
"In the nineteen twenties, Grant Hood build a large coal tipple in the west end of town (Minersville). . . . Later the tipple was moved down river a short distance beside the Pomeroy Water Works."

Reference:
Meigs County Historical Society
Meigs County History Volume I
Pg. 18, Minersville History

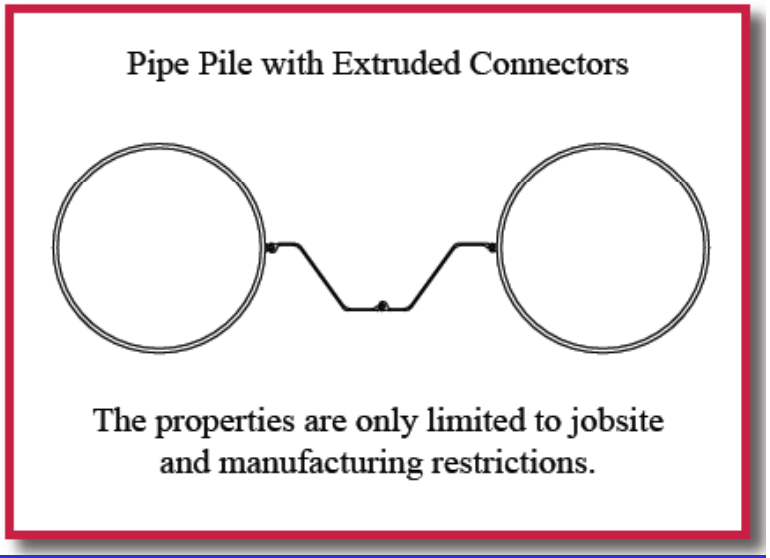
Relic Coal Transfer Points

Treatment Alternatives

- **Excavation and Reconstruction :** did not adequately address probable failure mechanism; costly temporary shoring and sheeting required during excavation due to risk of failure of roadway.
- **Drilled Shaft Wall :** uncertainties related to soil arching effect of slag/cinders/refuse between shafts; estimated cost greater than sheet pile wall
- **Post and Panel Wall :** prohibitively expensive due to excavation and backfill costs (double handling of stone); would require temporary shoring measures during excavation.
- **Sheet Pile Wall :** Cost effective alternative; some risk involved with potential subsurface obstructions (boulders, relic stone wall) and vibration related concerns.

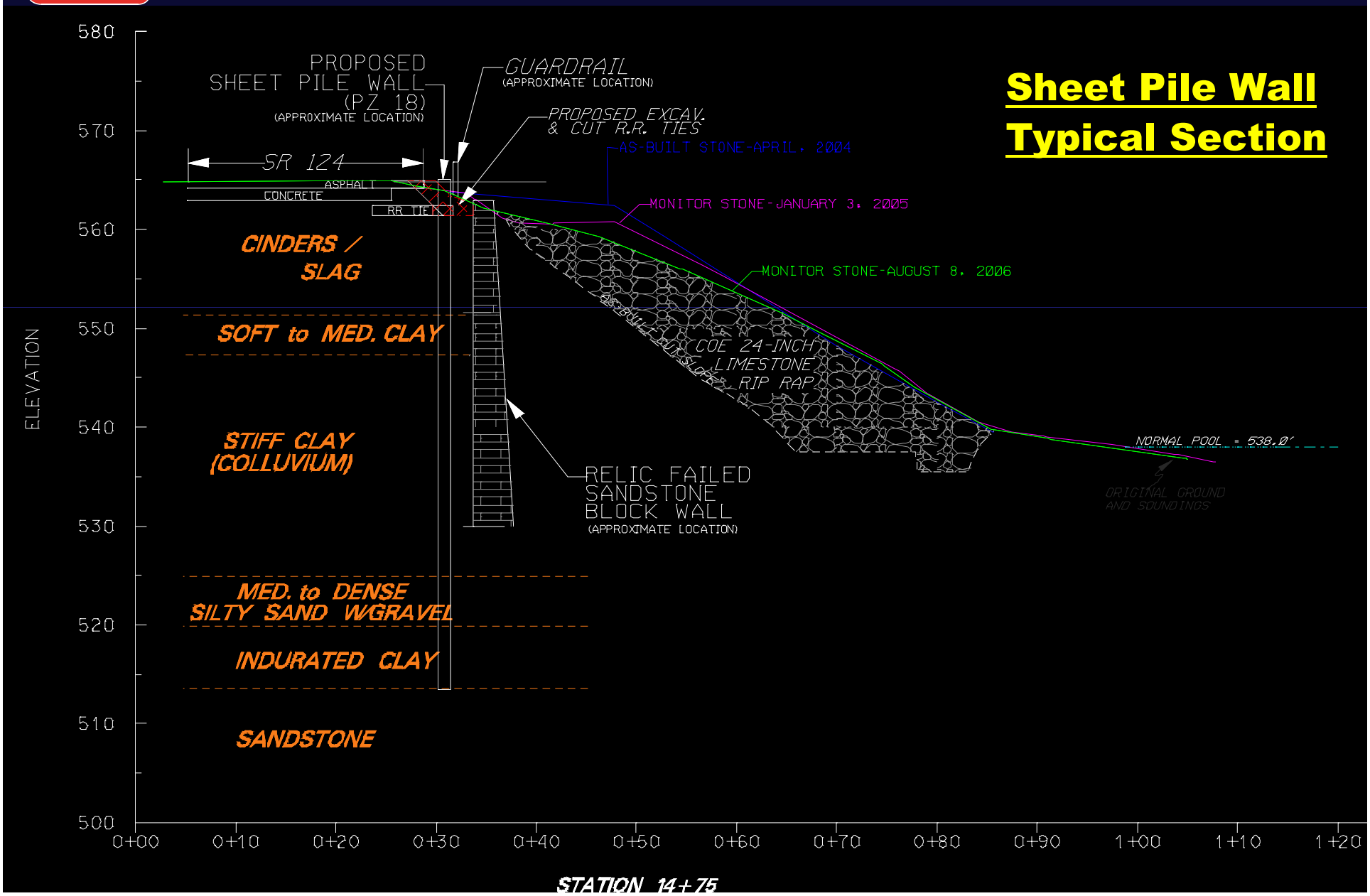
SELECTED ALTERNATIVE

Sheet Pile Wall w/King Piles:
Cost effective; Reduces risk related to inability of driving sheet piling due to subsurface obstructions.



Detail taken from: www.lbfoster.com/

Sheet Pile Wall Typical Section



Pile Driving

3 vibratory hammers used during driving (2 failed during driving)

Initially unable to drive 7 sheets to required depth; encountered large boulders (sandstone blocks); Able to re-drive sheets with larger hammer

Drove sheet thru areas of N=50+ blow counts to top of sandstone bedrock.

Vibration Monitoring

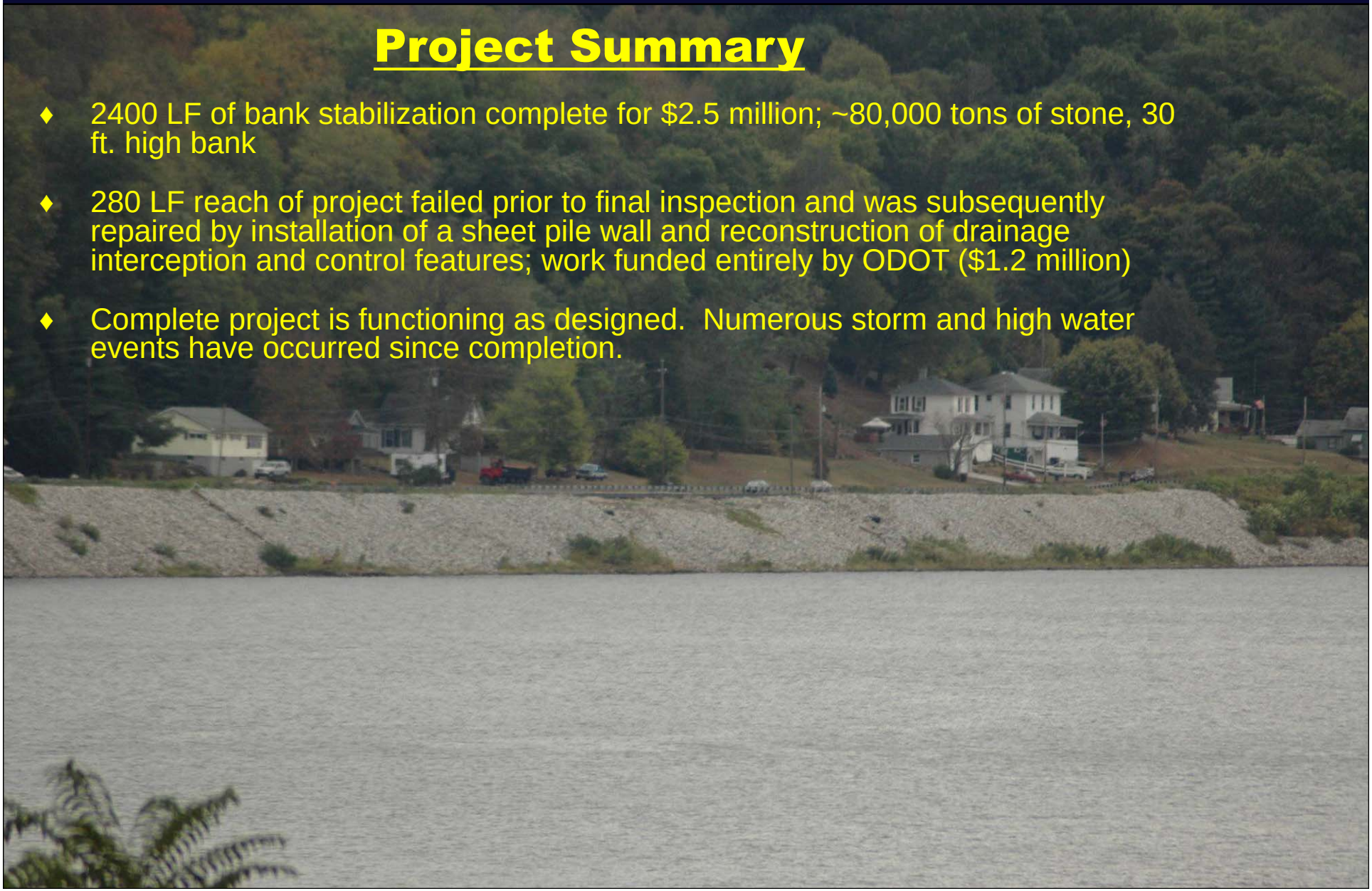
- Vibration related concerns stemming from prior litigation following original Sec. 14 project construction.
- Pre and post inspection surveys completed on all adjacent properties by private contractor specialist.
- Glass rods installed on foundation blocks.
- Ground vibration monitoring throughout construction via seismic instruments.
- Ground vibrations never exceeded 10% of allowable horizontal accelerations.
- No structural changes from ground vibrations as the results of the project. No complaints from residents.

Drainage Interception and Control

- >40,000 acres of abandoned coal mines up dip of SR 124.
- Mine discharge, storm event runoff, and Ohio R. inundation cannot be fully addressed by sizing collection structures and cross drains.
- Collapse of an adjacent collection vault (20 x 6 x 4 ft.) and blockage of cross drains was the most significant cause of displacement of SSP.
- ODOT completed repairs of the vault cover.
- USACE Contractor reconstructed drop inlets and cross drains.

Project Summary

- 2400 LF of bank stabilization complete for $2.5 million; ~80,000 tons of stone, 30 ft. high bank
- 280 LF reach of project failed prior to final inspection and was subsequently repaired by installation of a sheet pile wall and reconstruction of drainage interception and control features; work funded entirely by ODOT ($1.2 million)
- Complete project is functioning as designed. Numerous storm and high water events have occurred since completion.



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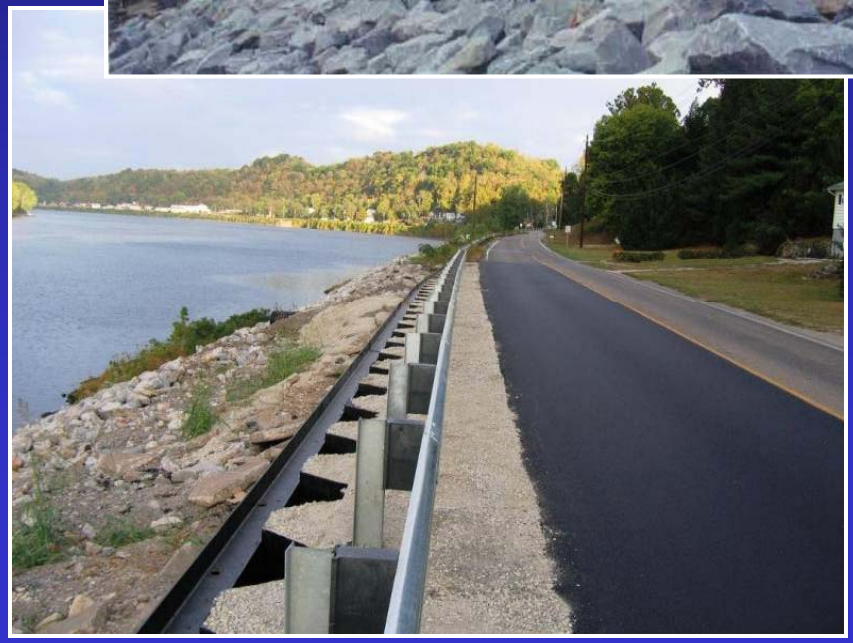
General Recommendations

- Perform comprehensive evaluation of site condition including relic structures and history of land use and failures.
- Subsurface explorations are necessary to properly characterize the site.
- Establish foundation requirements; Key-in SSP treatment & place on suitable filter and/or in-place soils.
- Review hydrometerological data and perform construction during historical low water/rainfall periods.



Conclusions

- Riverbank projects are complex. There are inherent risks building along rivers.
- Retain a team of experienced professionals for design and construction.
- Use an experienced contractor with supervisory and inspection staff.

Credits

- Ohio Department of Transportation (ODOT) District 10
- Madison Coal & Supply (Construction Contractor)
- Michael F. Spoor (USACE Lead Engineer)
- USACE Construction Division