State Route 28 – Cut Slope Performance in Landslide and Rockfall Prone Units – A 20+ Year History

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Project Location

SR 28 – Millvale to Etna
Project Description

- 1 Mile Long Section of Roadway-2 Lanes Each Direction, No Median Barrier, Shoulders 0-4 feet

- Located Between a 250’ High Slope, an Existing Railroad and the Allegheny River.

- Pennsylvanian Age Geology
  - Massive, Heavily Jointed Sandstones and Shales Interbedded with Thin Coal and Limestone Seams
  - Several Red Claystones including the Notorious “Pittsburgh Red Beds”
Project Description

• Existing Roadway Plagued with Rockfalls and Landslides due to Differential Weathering

• Rockfalls / Slides often Block One or More Lanes, Especially During Wet Spring Season

• Project Involved Widening Roadway to 4 Lanes with a Median Barrier and Full Shoulders & Cutting the Hillside to a Stable Condition

• Design Included Benched Cut Slope to Prevent Undercutting & “Washington (Ritchie) Ditch” to Prevent Rockfalls from Reaching the Roadway.
Project Stratigraphy


1 Name used in Pittsburgh area and southwestern Pennsylvania excluding Somerset County.
2 Name used exclusively in Somerset County.
3 Name used exclusively in Pittsburgh area.
Geology (continued)


Project Stratigraphy

(Marker Bed)
Existing Conditions – Geologic Profile

- Connellsville Sandstone
- Sandy Shale, Siltshale and Claystone
- Wellersburg Clayshale and Claystone
- Birmingham Shale
- Duquesne Coal & Shale
- Shale and Claystone
- Pittsburgh Red Beds
- Bakerstown Coal & Carb Shale
- Sandy Shale, Siltshale and Claystone
- SR 28 Profile Grade
Existing Conditions (1985)
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Birmingham Shale (Block)
Existing Conditions (1985)

- Residential neighborhood
- SR 28 Grade
- Railroad Grade
- Allegheny River
Existing Conditions (1985)

Transmission Line Tower

Millvale Interchange
Design Constraints/Objectives

• Avoid Costly ROW – Homes Located at Top of Slope

• Avoid Existing Power Transmission Lines at South End of Project

• Stabilize Slope to Prevent Future Landslides and Prevent/Minimize Rockfalls

• Prevent Future Rockfalls from Reaching Travel Lanes

• Minimize Future Maintenance
Reconnaissance of Existing Area Cut Slopes in Pittsburgh Red Beds

- Existing Slopes in the Pittsburgh Red Beds are Performing Adequately at a 1:1 Slope Ratio

- Cutting Red Beds Steeper than 1:1 Reduces Rate But Does Not Eliminate Undercutting
Design – “Washington Ditch”

Design – Proposed SR 28 Template
Design – Station 202+00
Design – Station 210+00
Design – Station 216+00
Completed Soldier Pile Wall
Completed Cut Slope (~ 1990)
Completed Cut Slope (~ 1990)
Completed Cut Slope (~ 1990)
Completed Cut Slope (~ 1990)
Completed Cut Slope (~1990)
Current Conditions (2013)
Current Conditions (2013)
Current Conditions (2013)

Rockfall Contained in Washington Ditch
Current Conditions (2013)

Stable Heavily Vegetated Slope
Current Conditions

Isolated Rockfall Caused by Undercutting of Birmingham Shale – Contained in Washington Ditch
General Comparison of Criteria
Washington Ditch vs FHWA, 2001

95% Rockfall Retention
Ref: Pierson et al, FHWA-OR-RD-02-04, 2001
Conclusions

• 1:1 Cut Slope in Pittsburgh Red Beds Effective Long-Term Solution to Prevent/Reduce Undercutting

• “Washington Ditch” has Provided Positive Rockfall Protection for the Travel Lanes for more than 20 years

• Rockfall Events Isolated to Cut Slope Transition Areas

• Cleaning of Rockfalls Difficult without Removal of Guardrail. Subsequent Development of “Rockfall Catchment Area Design Guide” (FHWA-OR-RD-02-04, 2001), Eliminates the need for Guardrail.
Questions?