

Zero Slump Grout for Remote Closure of Mine Openings

B. Petri, MS, PE

N. Rouse, PhD, PE



RESPEC

OVERVIEW

- Case study of closure technique
 - Low slump grout
 - Remote closure procedure
- Application to
 - Mine closures
 - Subsidence prevention



PROJECT BACKGROUND

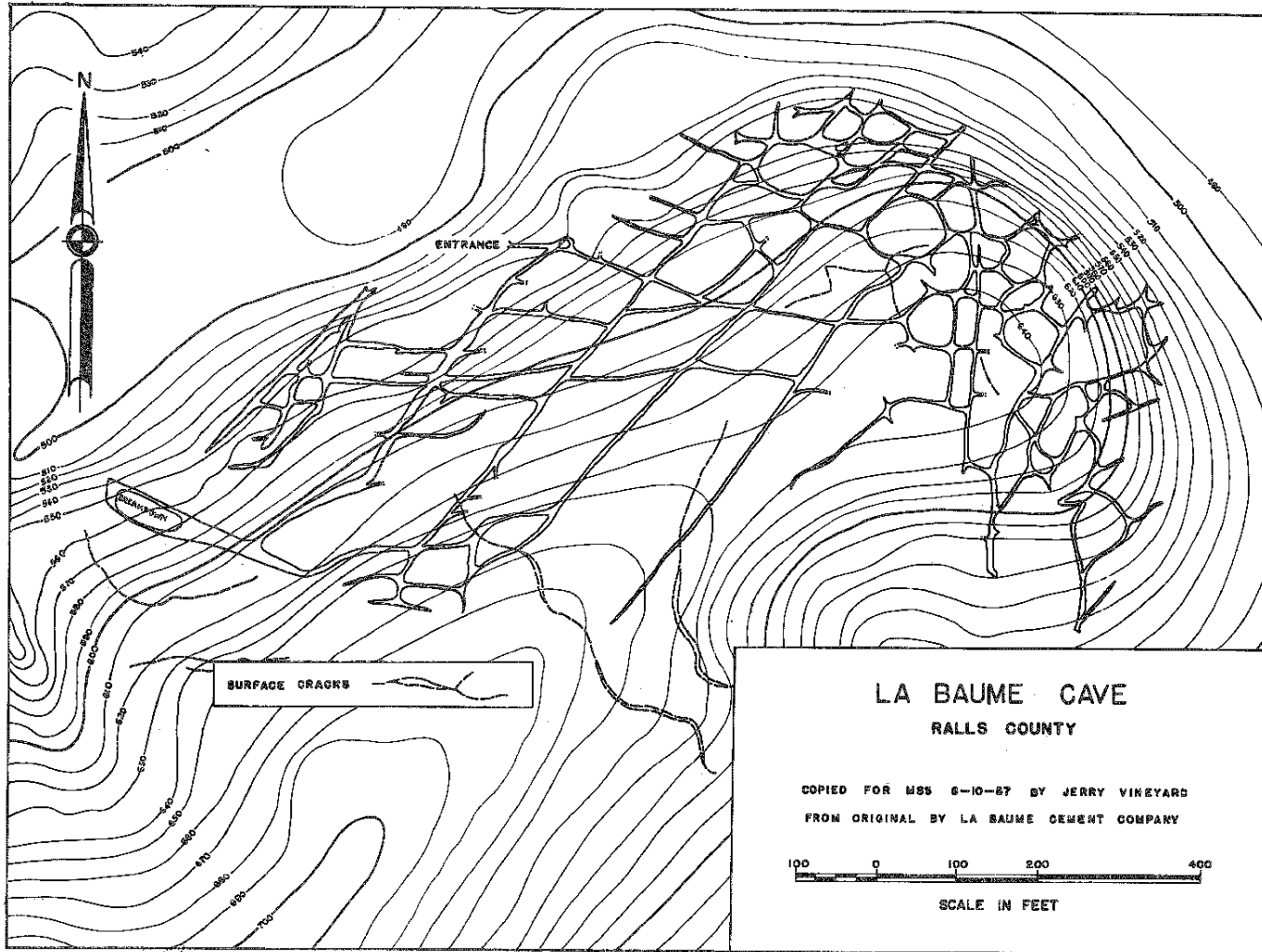
- Overland conveyor
 - Heavy steel truss supports
 - Concrete foundations
- Karst features discovered
 - Shale/limestone contact

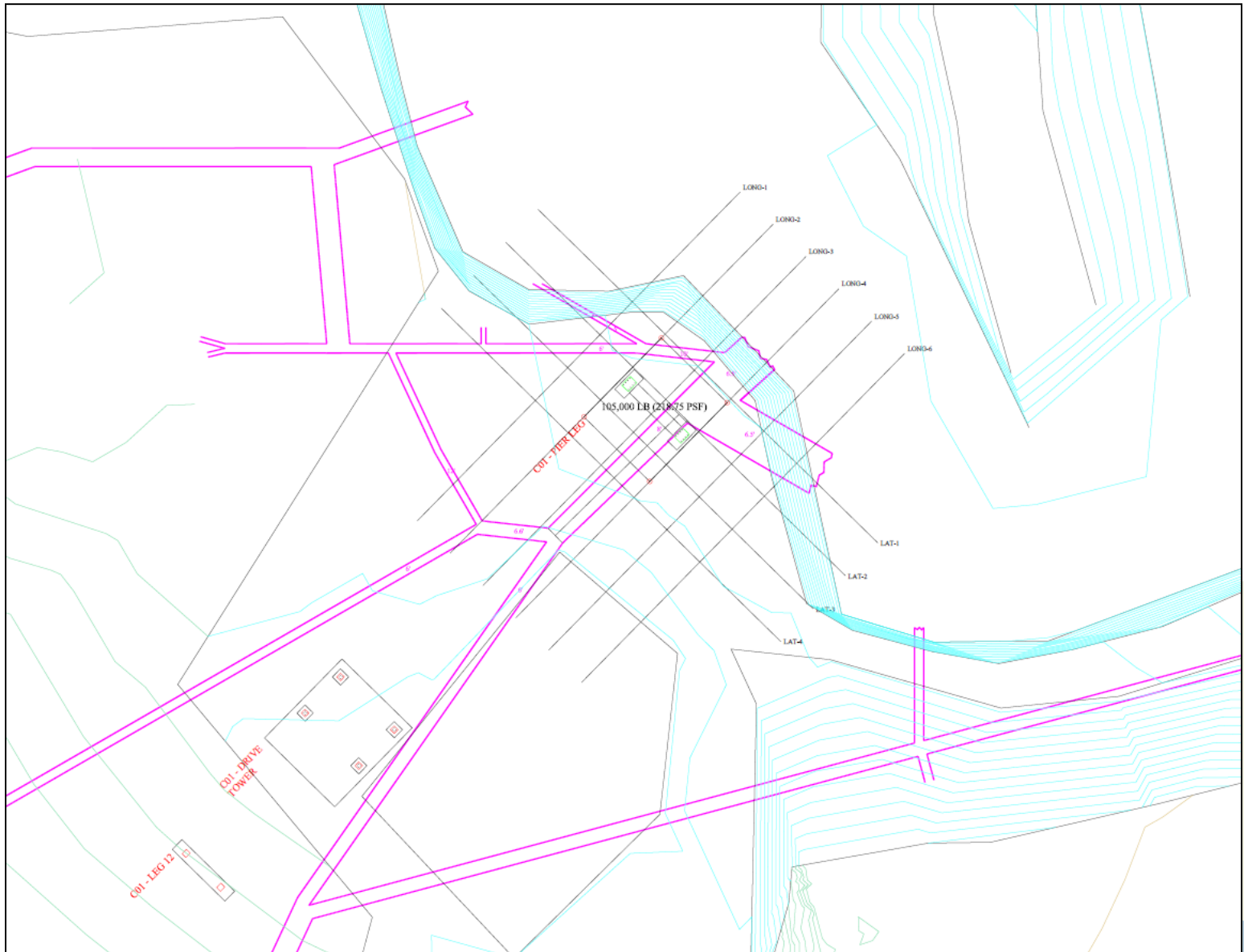


SITE SURVEY

- Extensive network
- Mapping required







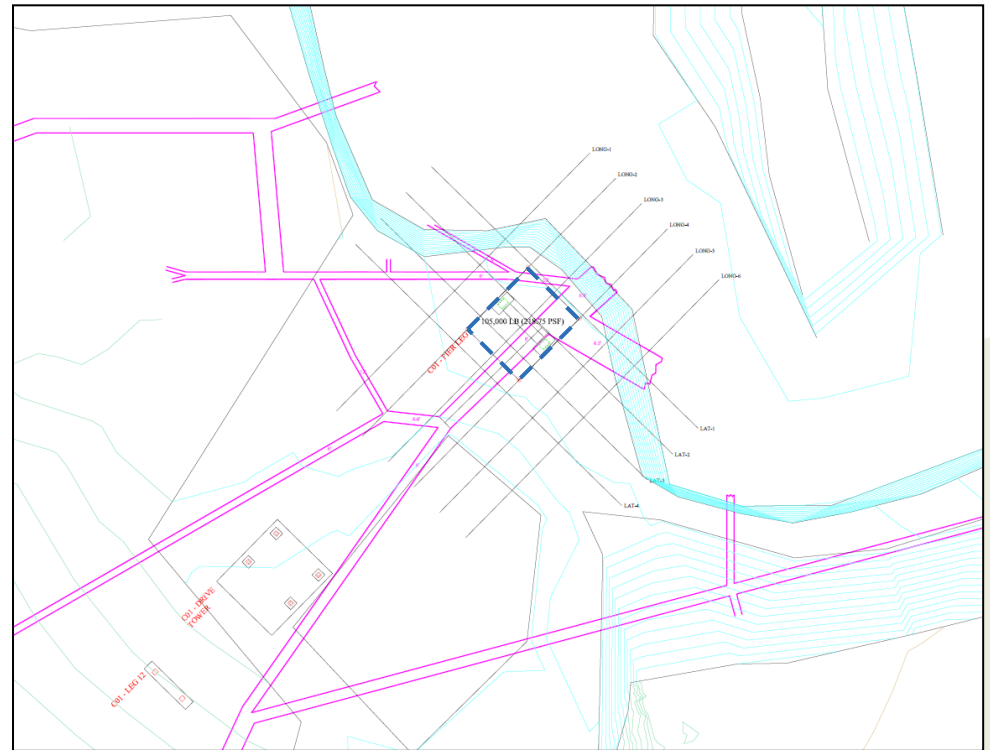
PROBLEM STATEMENT

- Extensive karst network
- Additional loading
- Weathering of shale
- Structural analysis required



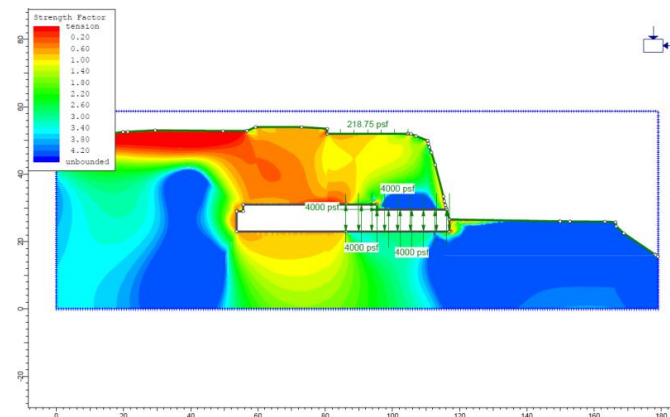
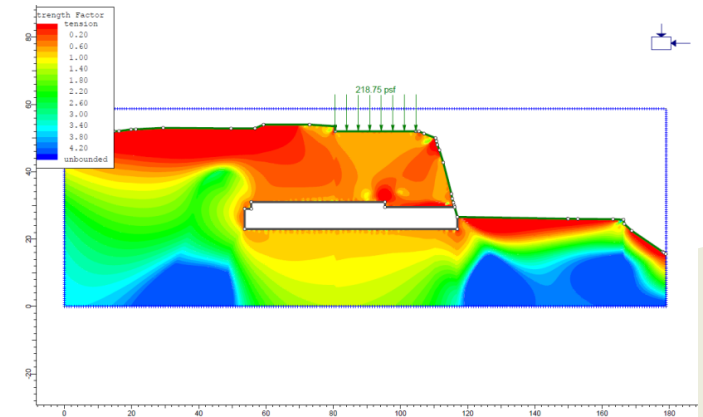
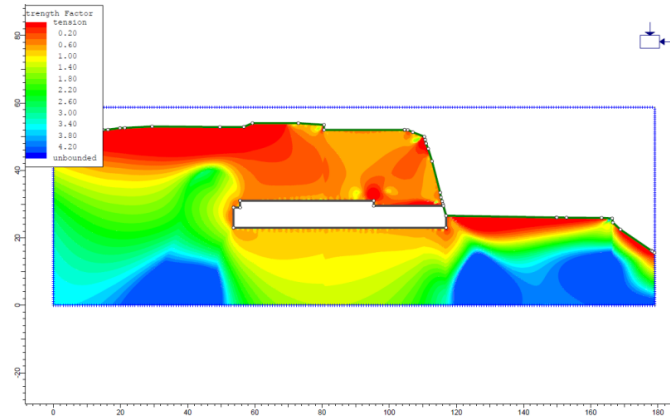
ANALYSIS

- Rocscience Examine2D
 - 2D stress analysis
 - Simplified uniform
- 11 cross sections
 - 6 longitudinally
 - 4 perpendicular
 - Centerline of primary cave

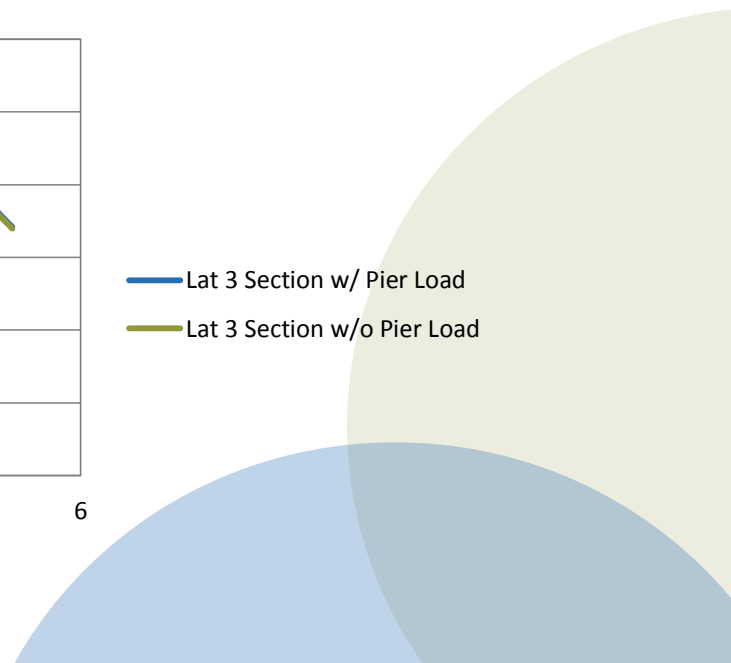
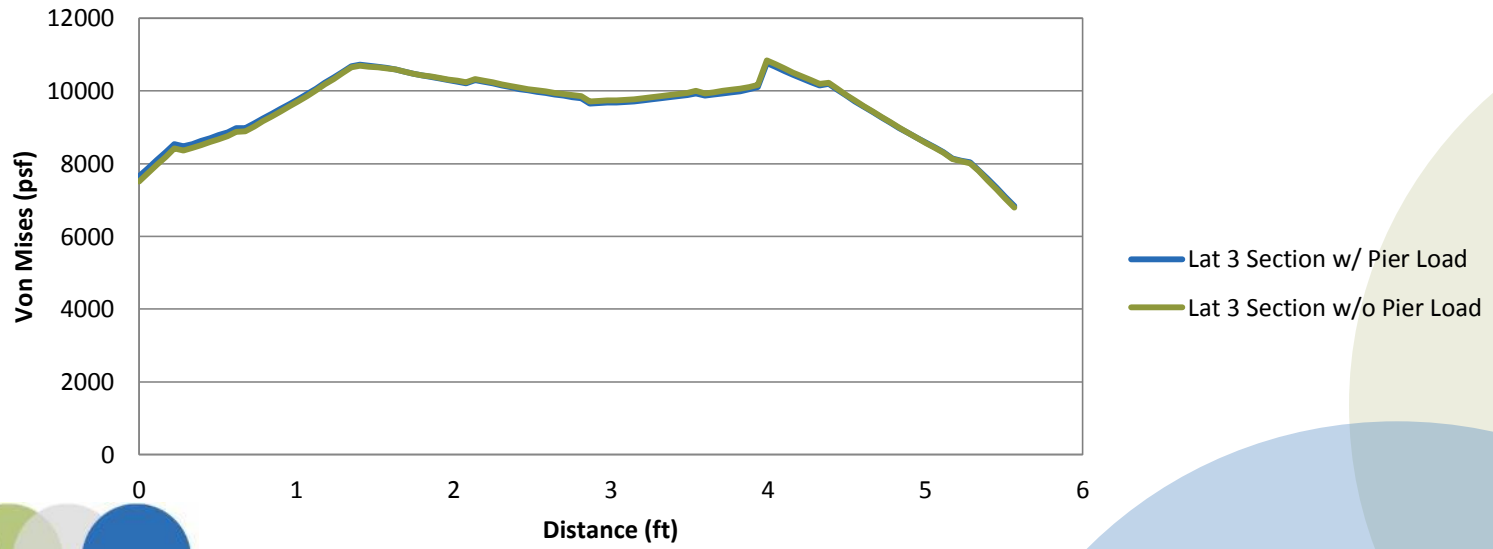
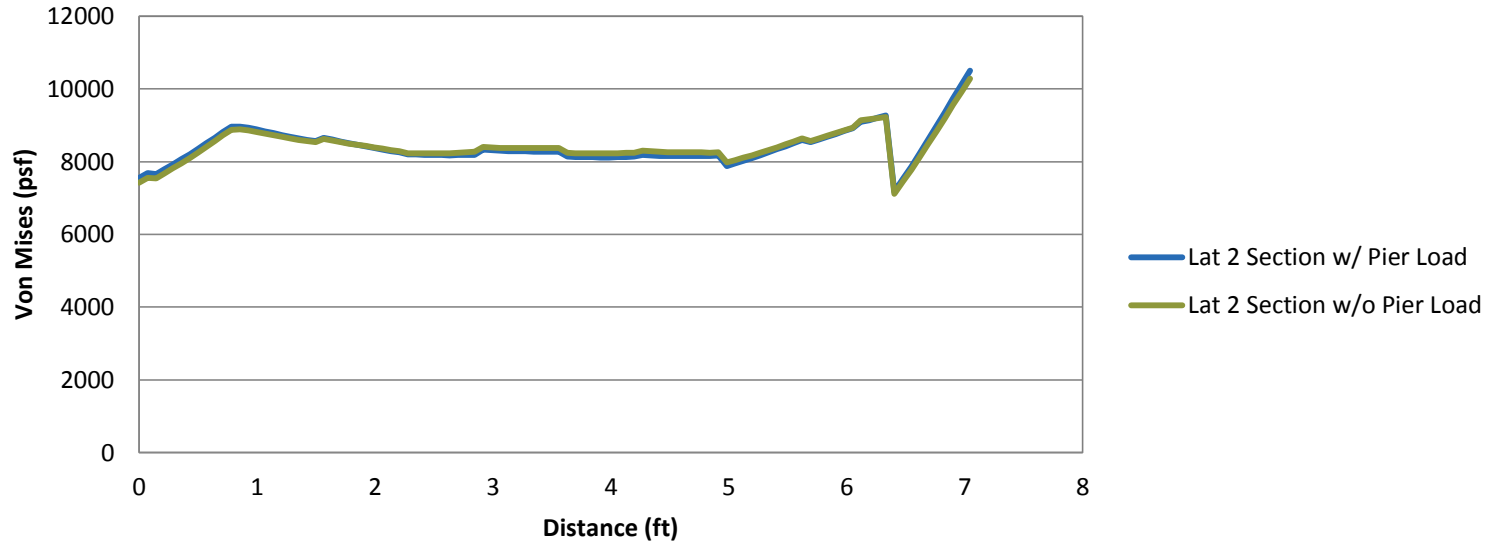


ANALYSIS

- Material properties
 - Drilling campaign
 - Grassy Creek
 - 4,679 psi UCS
 - Maquoketa Shale
 - 4,210 psi UCS
 - Generalized Hoek-Brown
 - 4,000 psi
 - Poisson ratio 0.19
- Additional loading
 - Pier tower load
 - 105,000 lb
 - 218.75 psi



ANALYSIS RESULTS



CLOSURE PROCEDURE

- Karst network monitored
 - Formation of cracks
 - Longitudinal within shale
 - Weathering induced
 - Superficial in nature
- Closure plan
 - Low slump grout dam
 - Flowable concrete backfill



GROUT PROPERTIES

- 4.5 bag mix
- 2,500 psi compressive strength
- 2 inch max slump
- Superplasticizer
 - 2 gallons modified in field
 - Resulted in minus 2 inch slump



CLOSURE PROCEDURE

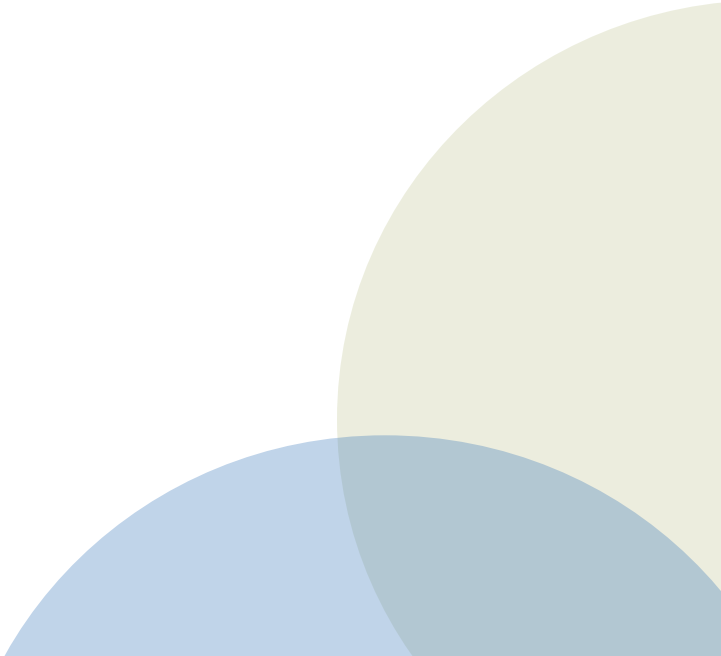
- Grout pumped a distance of 30 ft. from highwall
- Low slump pressure bulb
- Flowable fill to full height



CLOSURE PROCEDURE

- Minimal clearance between backfill and roof





SUMMARY

- Mine Closure and Subsidence Prevention
 - Low slump grout pressure bulb
 - Flowable high strength backfill
 - Minimize voids between fill and crown
 - Provide structural support
 - Ability to pump distances
 - Minimize risk to personnel



Brad Petri

brad.petri@respec.com

Nathan Rouse

nathan.rouse@respec.com

