

Bluestone Dam

AAR – A Case Study



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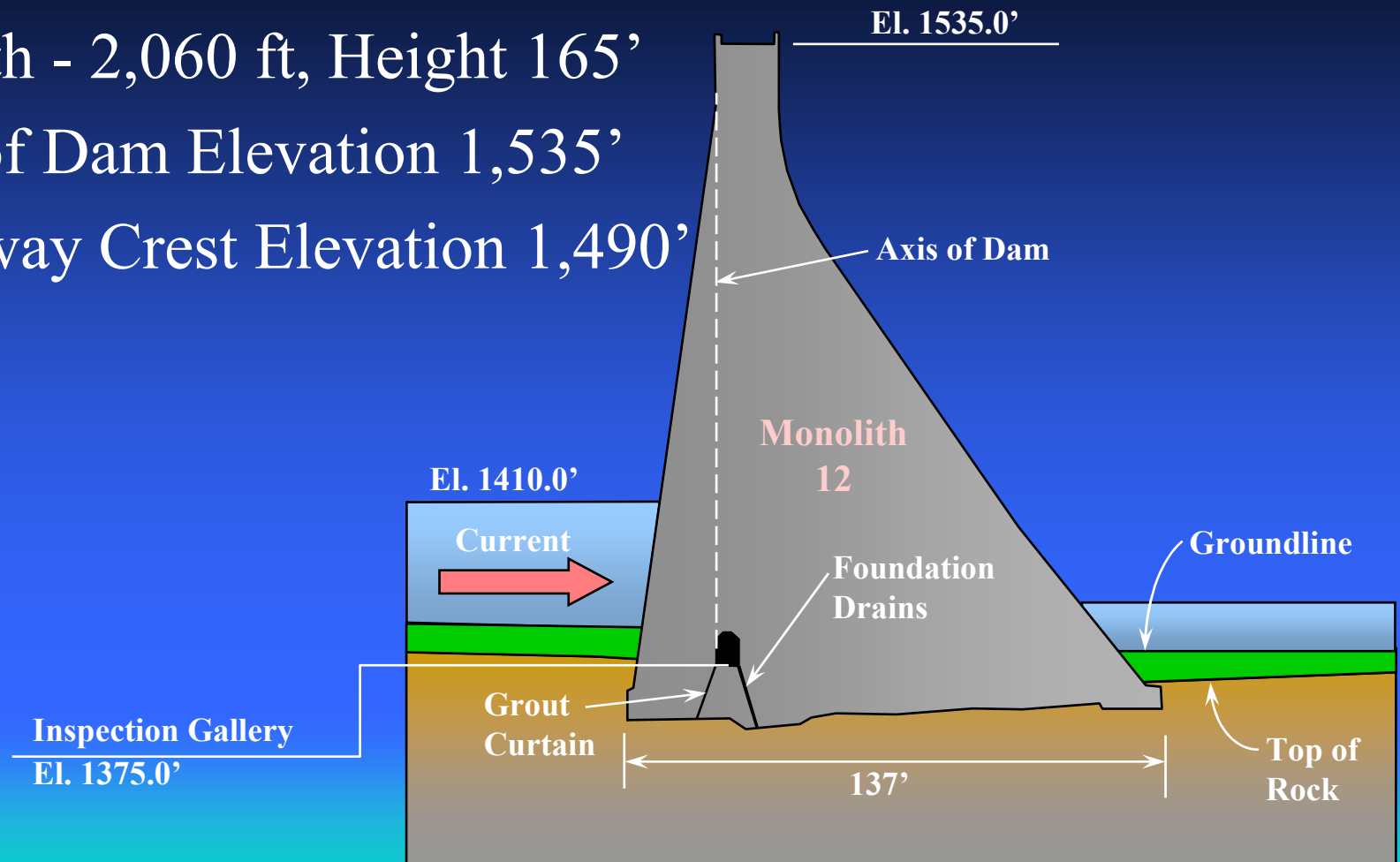
Presentation Overview

- Site Overview
- Ongoing DSA Projects
- AAR Project Issues
- Sample Retrieval
- Laboratory Testing
- Conclusions



Bluestone Dam – Existing Project

- Concrete Gravity Dam - 1940's
- Length - 2,060 ft, Height 165'
- Top of Dam Elevation 1,535'
- Spillway Crest Elevation 1,490'







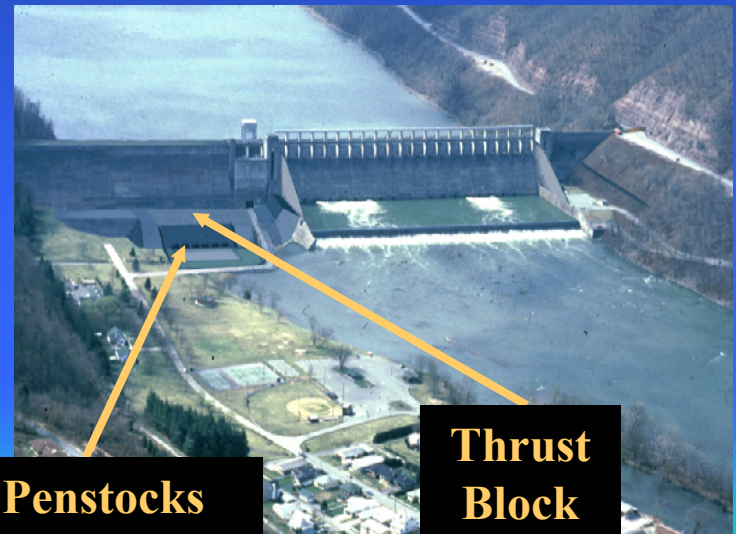


Bluestone DSA Phase I

- Project Features
 - 2 Lane Bridge
 - Thrust Blocks
 - Extending Penstocks
 - Sacrificial Bulkheads



Bridge

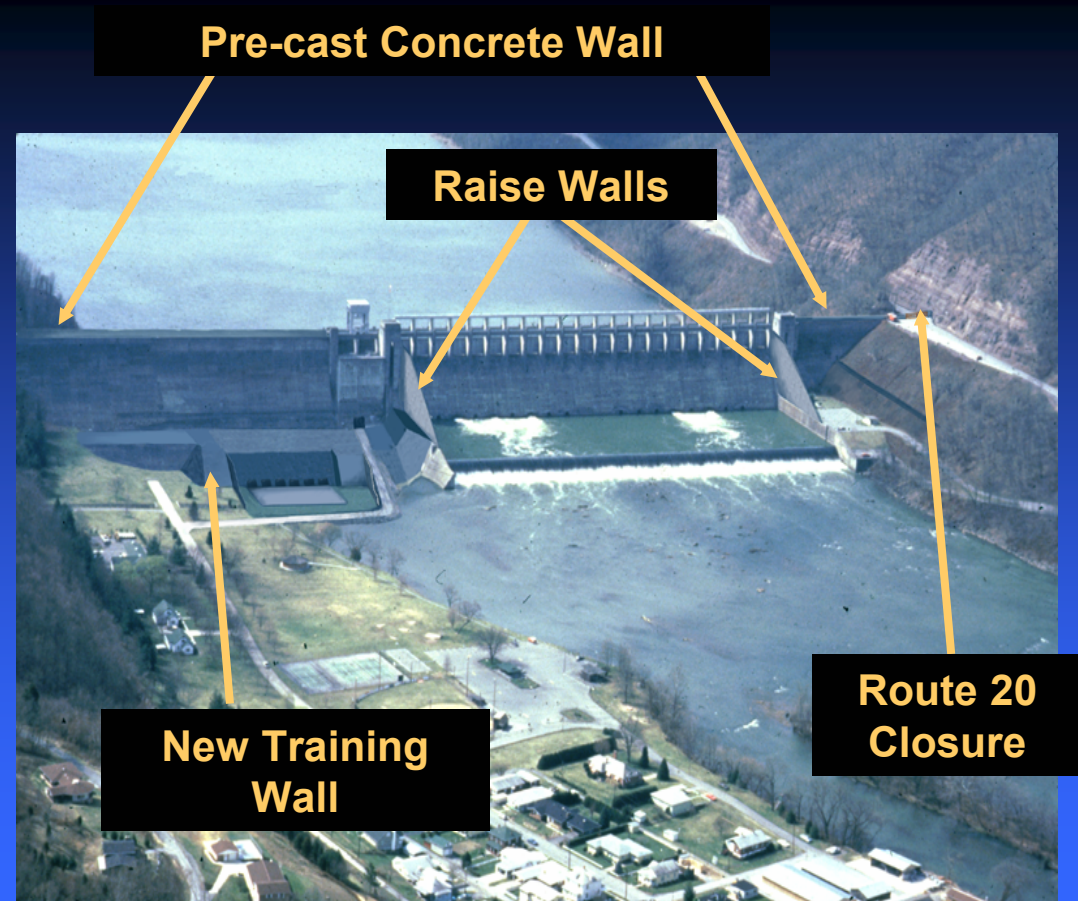


Penstocks

Thrust Block

Bluestone DSA Phase II

- Project Features
 - Rock Anchors
 - Parapet Wall
 - Rt 20 Gate Closure
 - New and Modified Training Walls



What is AAR?

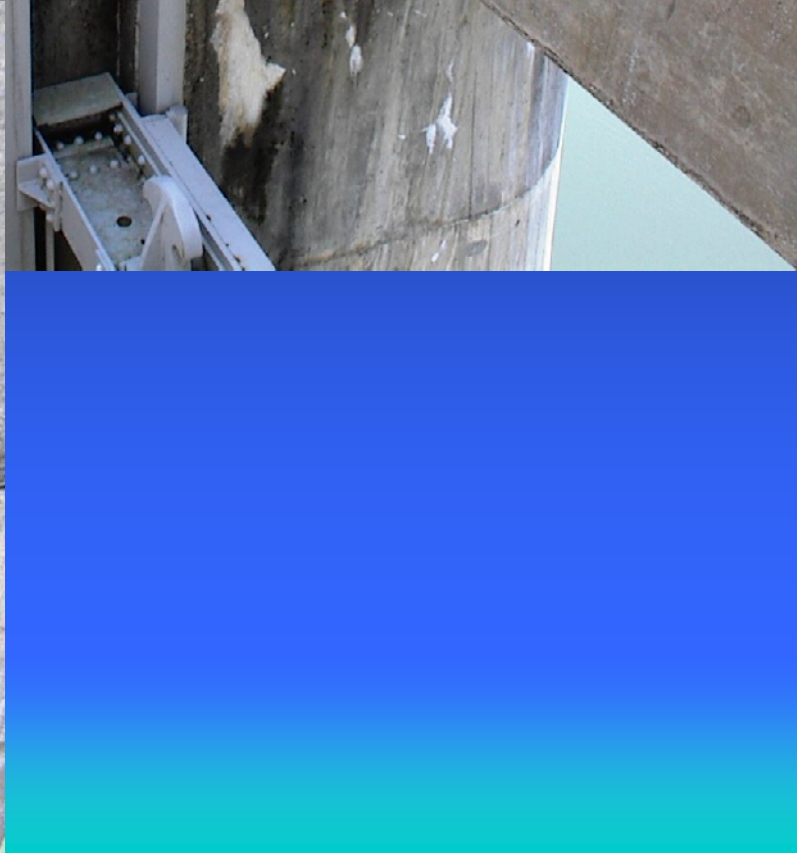
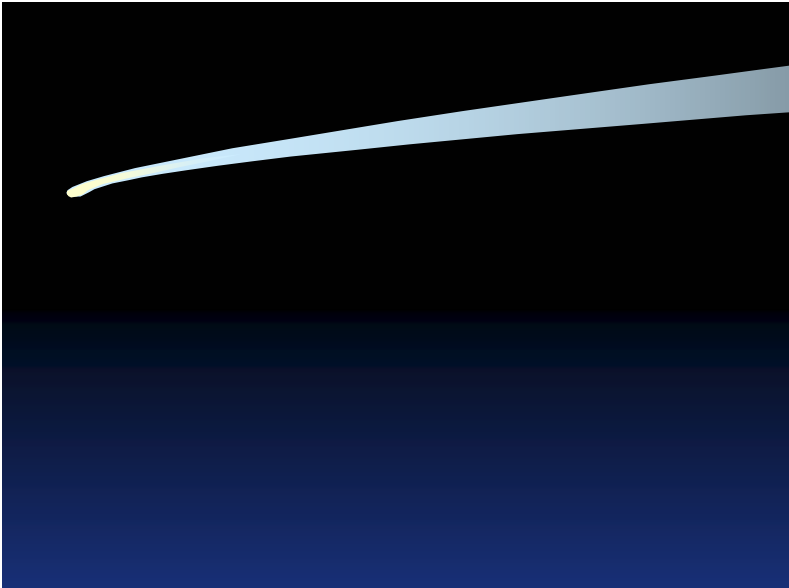
- Alkali Reaction with Silica (ASR)
- Alkali Reaction with Carbonates (ACR)
- Severity Influenced by:
 - Aggregate
 - Cement – Alkali
 - Humidity
 - Temperature
 - Stress Level
 - Time
- Decreased Serviceability and Design Life

Issues for Bluestone Dam

- Growth Mechanism – ASR or ACR?
- Growth Rate
- Impacted Areas of the Dam
- Compressive Strengths
- Influence on Planned Construction
- Same Quarry OK?





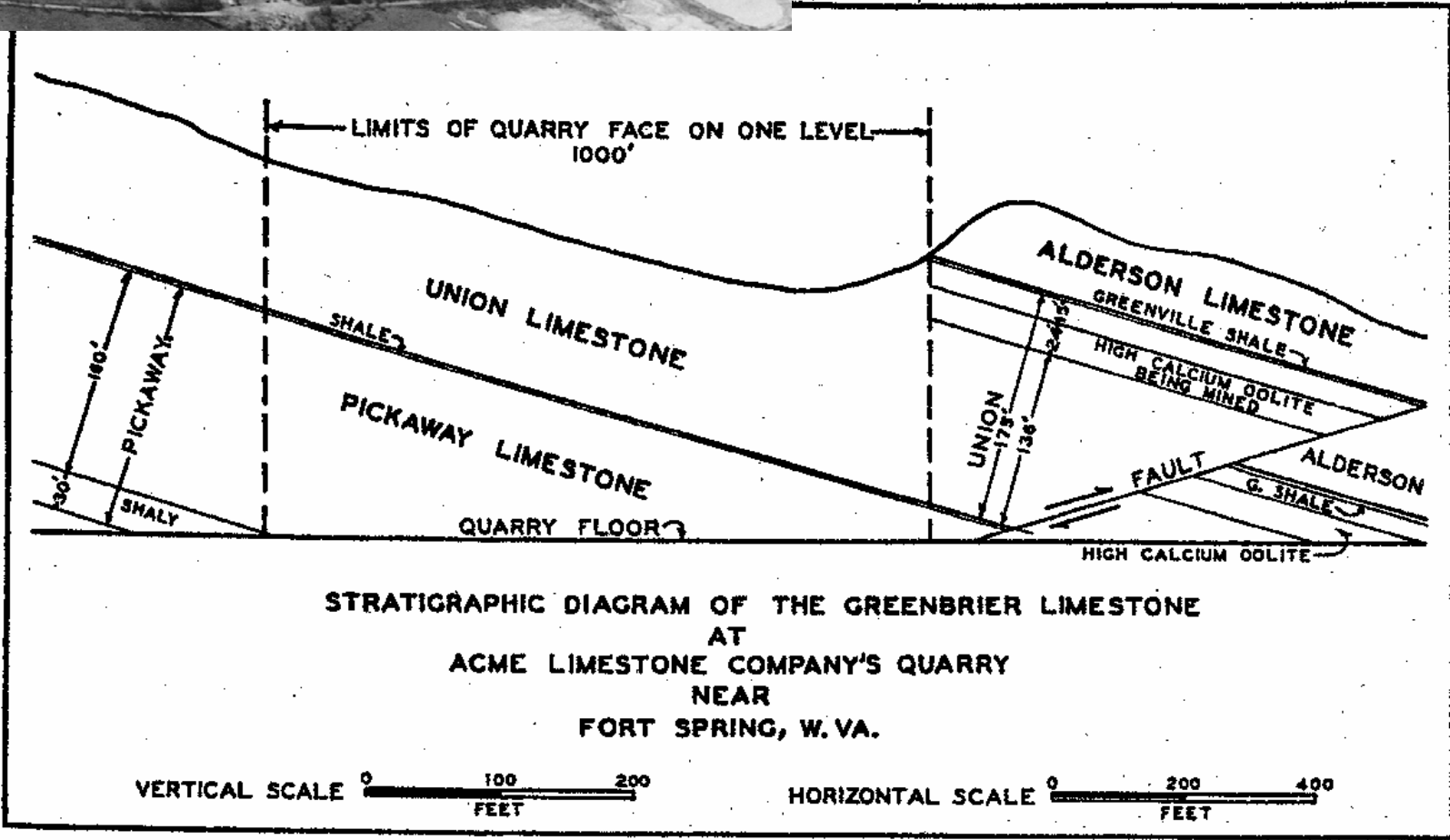








Snowflake Quarry - Potentially ASR Reactive



Sample Retrieval from Dam

- Roughly 30 Sample Locations
- 4” and 6” Thin Wall
- NQ, PQ and 3”
- Positioned Primarily in Spillway Bridge
- Selected other Locations
 - Galleries
 - Abutments

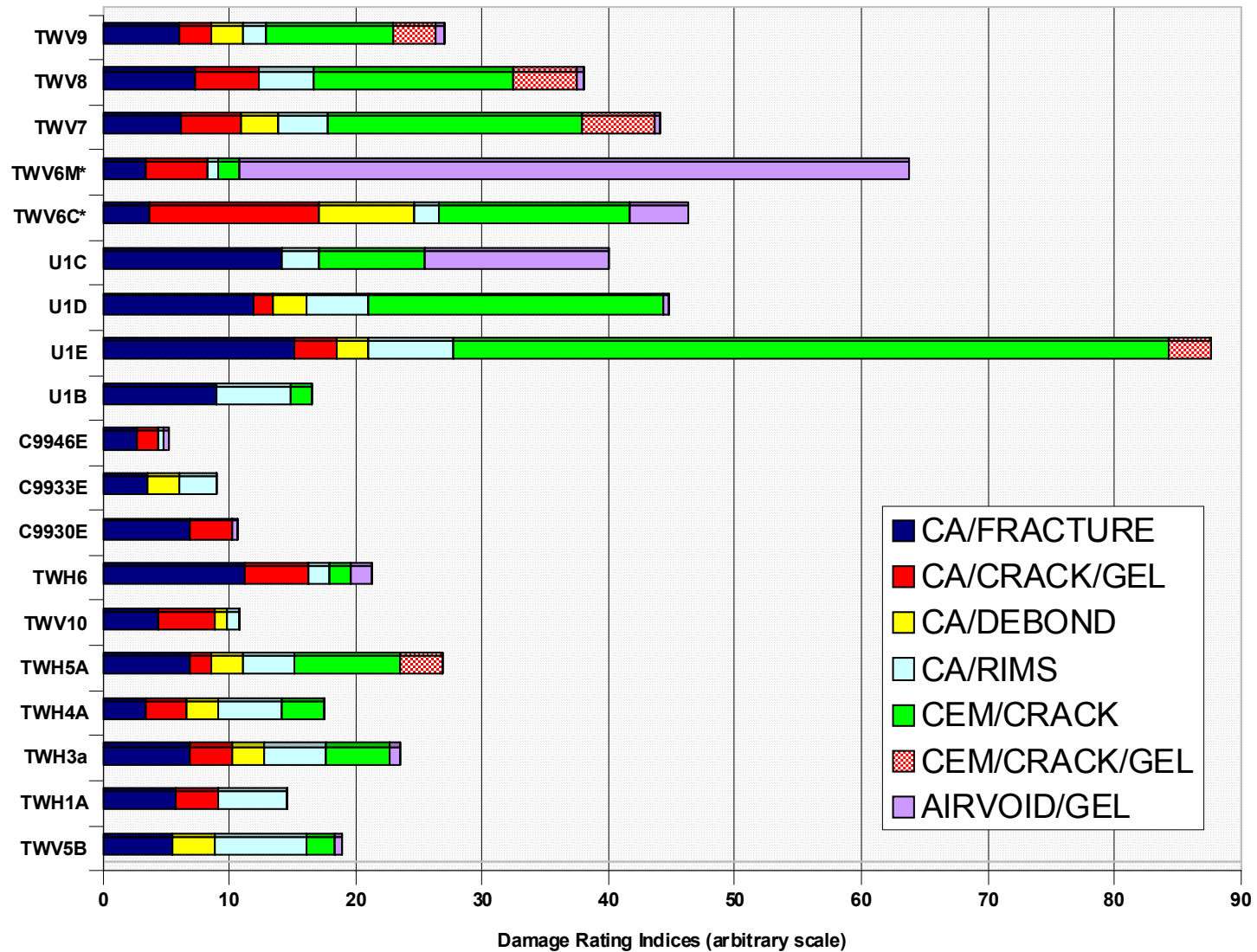
Damage Rating Indices

- Stereobinocular MS
- Mag = 16x
- Natural and UV Light
- Uranyl Acetate
- Gel Fluoresces
- DRI ~ 30

Weighting Factors for Determination of DRI	
Feature measured	Factor
Cracks in coarse aggregate	X 0.25
Cracks in coarse aggregate + gel	X 2.0
Open cracks in coarse aggregate	X 4.0
Coarse aggregate debonded	X 3.0
Reaction rims	X 0.5
Paste with cracks	X 2.0
Paste with cracks + gel	X 4.0
Gel in air voids	X 0.5

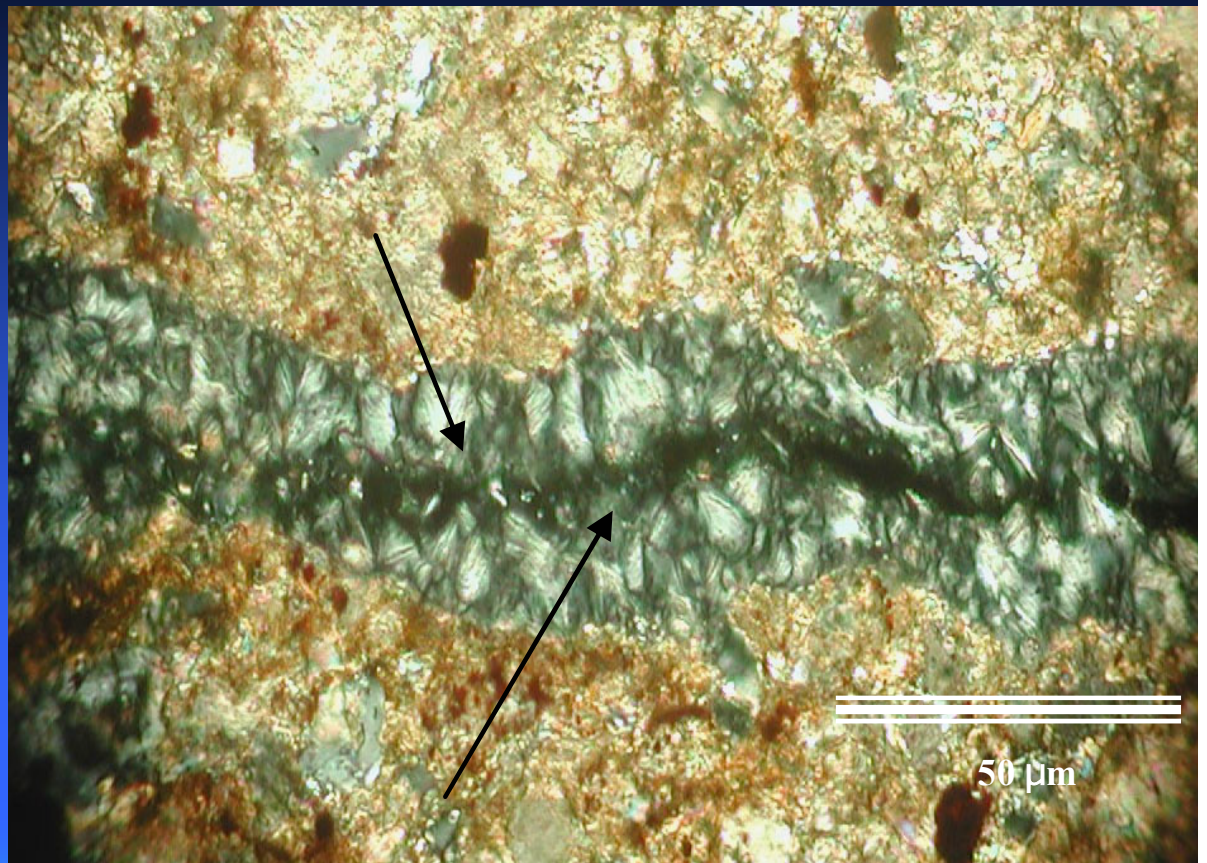
DRI Results

BLUESTONE DAM CORES



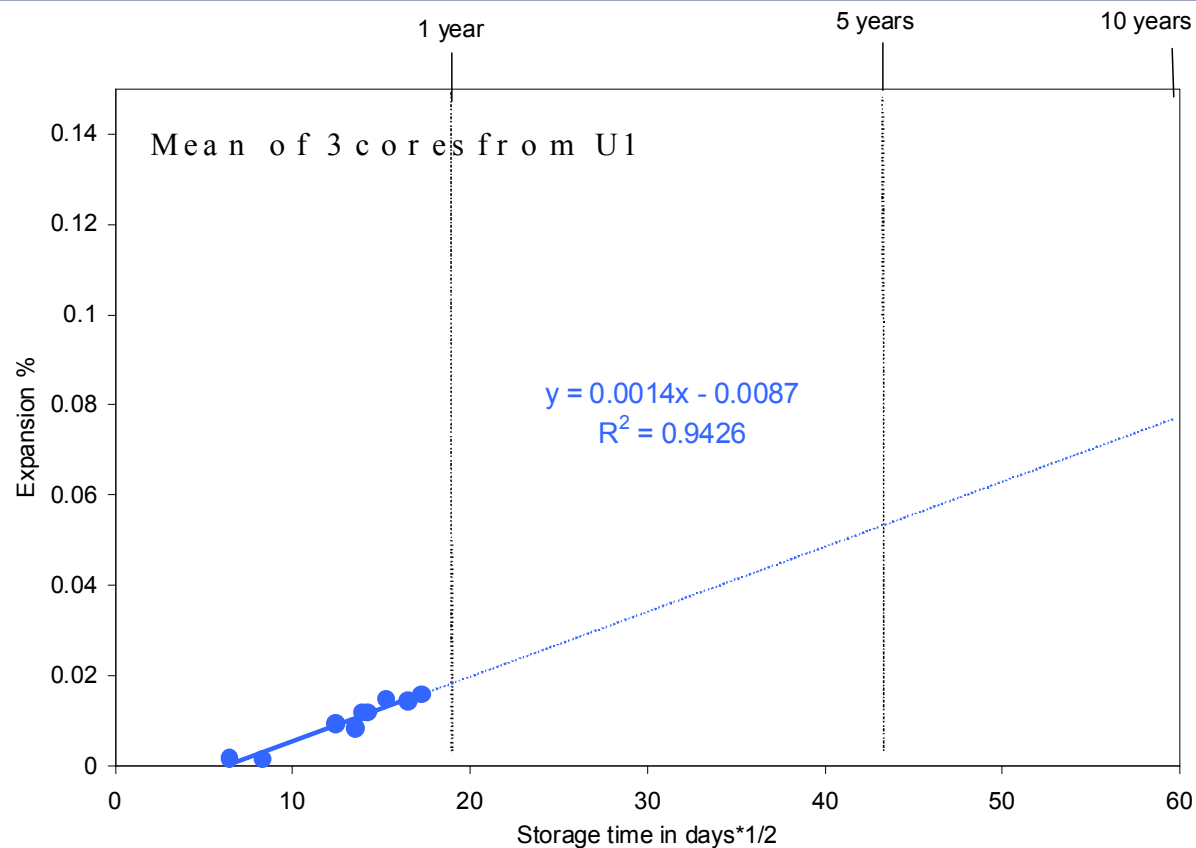
Petrography

- Alkali Silica Gel Observed
- Chert
- Chalcedony
- Greywacke
- Alkali Contents $< 2 \text{ kg/m}^3$

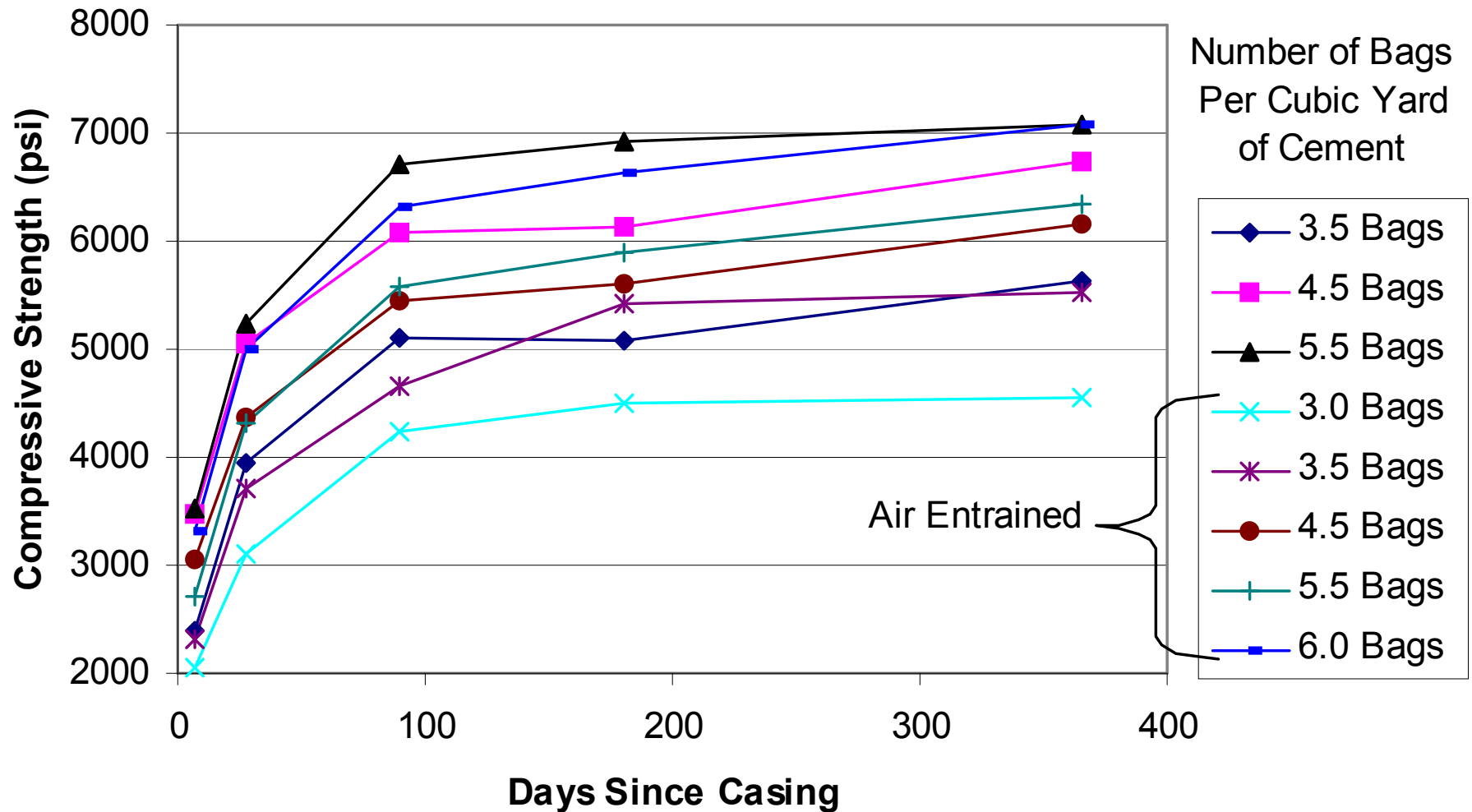


Expansion Tests

- On Cores, CSA A864-00
- 100% Relative Humidity, 38 C
- Over Water and w/NaOH Added – Insufficient Alkalis



Compressive Strengths – 1940s



Conclusions

- Growth Mechanism – ASR
- Growth Rate ~ Very Small
- Insufficient Alkalis to Support any Further Significant Expansion
- Compressive Strengths Decreased – Consider in Future Designs
- Spillway Bridge Capacity

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Questions ??



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