Wolf Creek Dam
Seepage
Major Rehabilitation Evaluation

US Army Corps of Engineers,
Nashville District
Outline of Topics

- Project Features
- Foundation Problems
- 1960’s Distress Indicators and Actions
- Post Wall Performance/Current Distress Indicators
- Proposed Remedy
EMBANKMENT PLAN

- Toe of Random Fill
- Cut Off Trench
- Drainage Blanket
• Treatment techniques inadequate for this geology
• Most of the alluvium left in place
• Except for cut-off trench, no embankment foundation treatment
• Cutoff trench design and construction inadequate
The bottom of this section of trench, at this stage of excavation, is still in overburden except for a few narrow areas where the rock salients showing in the overburden slopes were connected across the trench line. It is proposed to excavate the floor of the trench to continuous sound rock for the grout curtain. Overhangs and loose rock will be removed only where they cross the line of the trench, since the earthfill in the sides of the trench will have the function only of stability and not of an absolutely uniform tight contact with the trench walls. Tamping will supplement the regular rolling of the fill as required under the overhangs and irregular salients.
Before:

8-28-12/ Looking S in trench from vicinity embankment sta. 36410.

I-G. Note rock channel between points \(\omega\) and \(\pi\), with abrupt ledge floor at level of \(\nabla\). This floor was underlaid by solution weathered rock and was not continuous (see photo I-H). Above the floor, the walls were extremely irregular, with overhanging ledges. These were knocked off and weathered rock removed to condition shown in photo I-F.

After:

9-21-12/ Looking S in trench from vicinity embankment sta. 36410.

I-F. Note final condition of rock channel between points \(\omega\) and \(\nabla\) (see photo I-G). This channel is along line A of Exhibit 3. Note tapering continuation of the channel across intersecting channel.
4-2-42. Looking SE along hole at trench sta. 27+95. **IV-A**

4-2-42. Looking E across hole at trench sta. 27+95. **IV-B**

**IV-A** and **IV-B**. The hole is a solution widened joint, crossing the trench at right angles. Note differential solution and resulting overhangs in rock faces. These re-entrants were apparently well filled with silt.
19 November 1942
View of backfilling operations in cavity at Sta. 50+00 on cutoff trench
Solution Features
Looking from monolith 36 into cutoff trench where it ties into monolith 37
Pushing Soil into Cave

Embarkment

U/S

Monolith 37

Right Face of Monolith

D/S Face

Foundation Treatment
Initial Distress Indicators
1960’s

- SPILLWAY
- MUDDY WATER
- POWERHOUSE
- SINKHOLE 3-13-68
- SINKHOLE 4-22-68
- SINKHOLE 8-22-67
- SWITCH YARD
- WET AREA No. 1
- WET AREA No. 2
- WET AREA No. 3
- WET AREA No. 4
- WET AREA No. 5
- WET AREA No. 6

Dam Embankment
1968 Sinkhole

Switchyard

Sinkhole
Embarkment

Limestone

Seepage

Cutoff Trench

Grout Curtain

Development of Piping and Sinkholes
Earth Dam on Limestone Foundation
1960’s and 70’s Remedial Features

- Diaphragm Wall
- Concrete Dam
- Earth Emb
- Grout Lines
- Switchyard Wall
- Powerhouse
- Switchyard Wall
Profile along Diaphragm Wall

Diaphragm Wall in Emb

Concrete

End wall Sta. 57+50

TOP OF DAM EL. 773

TOP OF ROCK

TOP OF ALLUVIUM

LEIPERS

CATHEYS

Limestone Foundation

PROFILE ALONG AXIS OF DAM

Looking U/S
Diaphragm Wall

Typical Section
Post Wall Performance/Current Distress Indicators

- Piezometers
- Wet Areas
- Settlement
- Soft Zones
- Temperature Survey
- Other
High PZ Pressures

Areas of Highest PZ Pressures
Post Wall Performance – Wet Areas

Existing Diaphragm Wall
Post Wall Performance - Settlement
2002-2003 Resonant Sonic Investigations
Other Concerns/Distress Indicators

- Cool Spots from Piezometer Temp. Survey
- Cable Tunnel Seepage and Cracking
- Increased Seepage and Instability Problems in the D/S Riverbank
- Structural Integrity of Existing Wall
Reasons for Continuing Distress

- Seepage coming around ends of wall
  - Through features untreated beneath monoliths
  - Around right end where no wall exists

- Below wall through features untreated or partially treated by previous grouting

- Through defects in wall itself
Proposed Secant Wall

Step 1. Create panel wall of lean concrete to top of rock

Step 2. Drill overlapping caissons to form secant wall into sound rock

Step 3. Drill and grout below caissons

Embankment

Alluvium
Unconstrained Construction Cost By Fiscal Year

- Total Estimated Cost: $254M
- Fully Funded Cost: $272M

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Summary of Hazard Rates for Wolf Creek Dam

Time (years)

Hazard Rate

- 0.0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6
- 0.7
- 0.8
- 0.9
- 1.0

Section 1
Section 2
Section 3
Questions?
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