“Holey Ground”

An Assessment of the Safety of Gathright Dam with Respect to Seepage and Internal Erosion

Alex Rutledge, PE, PG

September 19, 2012
Outline

- Why
- Overview of our study
- Our primary concerns
- River Spring
- Select Findings and Recommendations
Portfolio Risk Management

Inventory of Dams (609)

Worst Screened First

Staff and Train Cadres

District searches Existing Files, Photos, PIs, Foundation Reports, WCM, etc

Deploy Cadres

Relative Risk Estimates

Consequences People and Dollars

Estimate Probability of Failure

Study Records, Interrogate Staff

http://samehuntington.com/shared/content/Presentations/TA_S1_Robinette.pdf
DSAC Ratings

• Based upon a combination of annualized loss of life (or annualized economic damages) and the engineering ratings (likelihood for poor performance).
USACE (1969) – Design Memorandum No. 11, Geology and Foundations, July 1969, Gathright Dam, Covington, VA.
USACE (1969) – Design Memorandum No. 12, Embankment and Spillway, September 1969, Gathright Dam, Covington, VA.
USACE (1971) – Foundation Conference, May 10-12, 1971, Gathright Lake Project, Covington, VA.
USACE (1971) – Board of Consultants’ Meeting on Foundation Treatment, October 18-20, 1971, Gathright Lake Project, Covington, VA.
USACE (1971) – Maps and Drawings to Accompany Foundation Conference, October 18-20, 1971, Gathright Lake Project, Covington, VA.
USACE (1972) – Plans for Embankment, Spillway, and Roads, October 1972, Gathright Lake Project (Drawings).
USACE (1975) – Maps and Drawings to Accompany Supplement to Design Memorandum No. 11, Appendix II, Geology and Foundations, Gathright Dam, Covington, VA.
USACE (1975) – Technical Briefing, Special Foundation Treatment, September 15-16, 1975, Gathright Lake Project, Covington, VA.
USACE (1976) – Supplement to Design Memorandum No. 11, Geology and Foundations, February 1976, Gathright Dam, Covington, VA.
USACE (1976) – Board of Consultants Meeting, February 18 – March 2, 1978, Gathright Lake Project, Covington, VA.
USACE (1979) – Plans for Collection Trench, November 1979, Gathright Lake Project, Covington, VA (Drawings).
USACE (1985) – Periodic Inspection Report Number 7, May 7-8, 1985, Gathright Dam & Lake Moomaw Project, Covington, VA.
USACE (1994) – Periodic Inspection Report Number 10, June 7-8, 1994, Gathright Dam & Lake Moomaw Project, Covington, VA.
Virginia Public Service Company (1929) – Geological Map and Structural Sections in Vicinity of Dam Sites, October 1929.
Site Visit - October 19 and 20, 2009
GATHRIGHT LAKE PROJECT
JACKSON RIVER, VIRGINIA

LOGS OF GEOLOGIC EXPLORATIONS
TO ACCOMPANY
PLANS AND SPECIFICATIONS
FOR
CONSTRUCTION OF EMBANKMENT & SPILLWAY

Schnabel ENGINEERING
Geologic Database - Input

181 Borings

All Borings
Licking Creek
Healing Springs
Coeymans
Upper Keyser
Clifton Forge
Lower Keyser
Tonoloway
Geological Cross Section
Data Digitization and Visualization
Data Digitization and Visualization
Voids!
## Geologic Database – Void Statistics

<table>
<thead>
<tr>
<th>Formation</th>
<th>Number of Holes</th>
<th>Linear feet of drilling</th>
<th>Number of Voids</th>
<th>Linear feet of voids</th>
<th>Average linear feet per void</th>
<th>Percent Voids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licking Creek</td>
<td>52</td>
<td>3075</td>
<td>34</td>
<td>89</td>
<td>2.6</td>
<td>2.9%</td>
</tr>
<tr>
<td>Healing Springs</td>
<td>86</td>
<td>2599</td>
<td>36</td>
<td>157</td>
<td>4.4</td>
<td>6.1%</td>
</tr>
<tr>
<td>Coeymans</td>
<td>72</td>
<td>2815</td>
<td>120</td>
<td>1238</td>
<td>10.3</td>
<td>44.0%</td>
</tr>
<tr>
<td>Upper Keyser</td>
<td>72</td>
<td>1454</td>
<td>31</td>
<td>170</td>
<td>5.5</td>
<td>11.7%</td>
</tr>
<tr>
<td>Clifton Forge</td>
<td>108</td>
<td>5135</td>
<td>20</td>
<td>37</td>
<td>1.9</td>
<td>0.7%</td>
</tr>
<tr>
<td>Lower Keyser</td>
<td>42</td>
<td>1837</td>
<td>5</td>
<td>8</td>
<td>1.6</td>
<td>0.4%</td>
</tr>
<tr>
<td>Tonoloway</td>
<td>31</td>
<td>1554</td>
<td>12</td>
<td>31</td>
<td>2.6</td>
<td>2.0%</td>
</tr>
</tbody>
</table>
Our Primary Concerns

- River spring
- Loss of core material by erosion and piping
- Reservoir seepage through existing solution features during flooding
- Development of bypass seepage path resulting in loss of reservoir
River Spring

First appeared on May 6, 1980

Dye testing
Geophysical studies
Drilling
Petrographical and geochemical studies
Dye testing
Springs in Gorge
River Spring System

River Spring
Stilling Basin
DAM
Tension at crest of anticline
Stilling basin: 1200 gpm artesian flow before reservoir filling
Summary of Findings

- River Spring System is primarily geologically controlled
- No evidence for direct connection of River Spring System with reservoir
- Seepage control features are performing as designed
- Cannot monitor performance of grout curtain beneath the dam
- Should monitor spring flows
Recommendations

River Spring System Mass Balance Study:
- Compare USGS stream gauge data to dam releases, precipitation, trench drain flow, and adit flow
ROV Survey
Proposed Borings and VR-Piezometers