



Schnabel
ENGINEERING



US Army Corps
of Engineers
Norfolk District

"Holey Ground"

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

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September 19, 2012

schnabel-eng.com

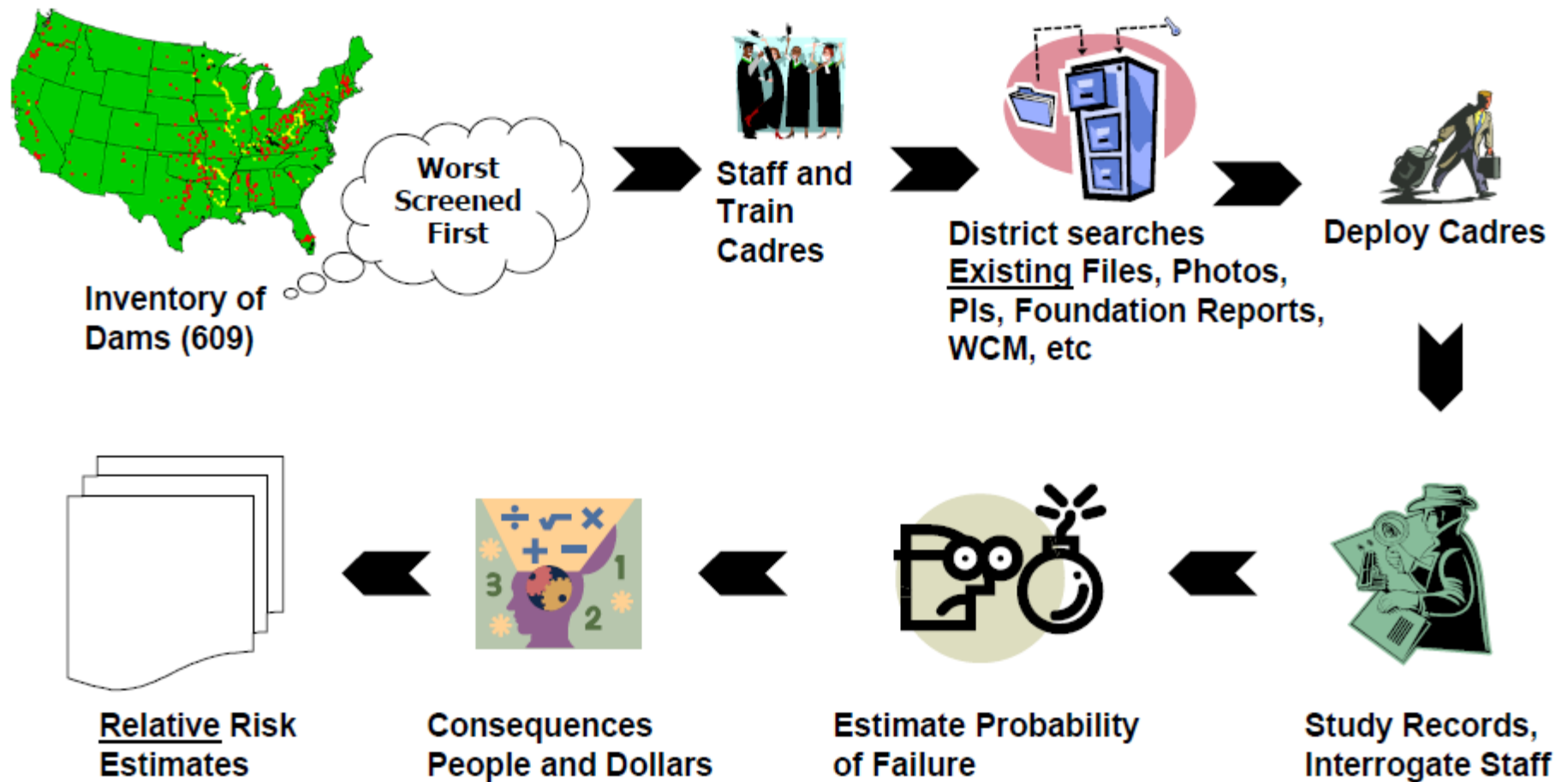
Outline

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



US Army Corps
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Portfolio Risk Management



Dam Safety Action Classification



US Army Corps
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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).

Class I
Urgent and Compelling

Class II
Urgent

Class III
High Priority

Class IV
Priority

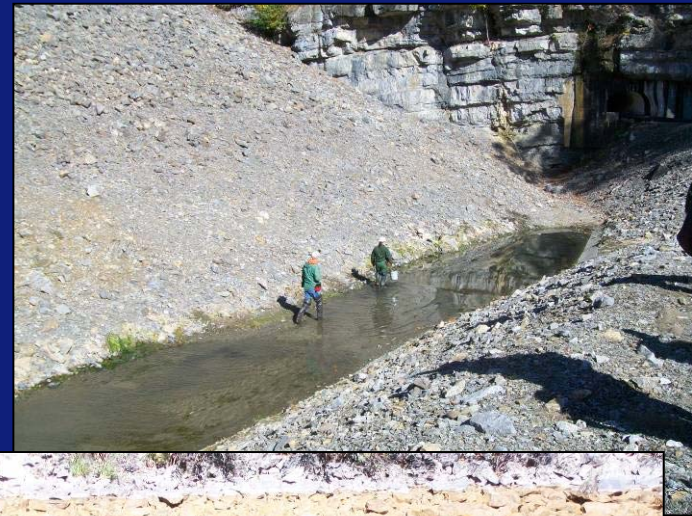
Class V
Normal



Literature Review

- 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 (1970) – Design Memorandum No. 17, Instrumentation, November 1970, 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 (1978) – Board of Consultants Meeting, February 18 – March 2, 1978, Gathright Lake Project, Covington, VA.
- USACE (1978) – Periodic Inspection Report Number 1, Oct. 3-4, 1978. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1979) – Plans for Collection Trench, November 1979, Gathright Lake Project, Covington, VA (Drawings).
- USACE (1980) – Spring Locations, March 1980, Gathright Dam and Lake Moomaw, Covington, VA (Drawing).
- USACE (1980) – Periodic Inspection Report Number 2, May 5-7, 1980. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1980) – Construction Foundation Report, October 1980, Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1981) – Periodic Inspection Report Number 3, June 2-3, 1981. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1981) – OCE Review Meeting Report, including Summary of 1978 Board of Consultant Report and Work Accomplished, Foundation Piezometers Installation, Testing and Response Report, Open Embankment Piezometers Installation Report, River Spring System Report, Embankment Performance Report, Reservoir Rim Slope Comments, and Foundation Piezometer Dye Test Report, Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1982) – Geophysical Investigation at Gathright Dam, Misc. Paper GL-82-2, March 1982, Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1982) – Periodic Inspection Report Number 4, June 8-9, 1982. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1983) – Periodic Inspection Report Number 5, May 10-11, 1983. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1983) – Embankment Criteria and Performance Report, October 1983, Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1984) – Periodic Inspection Report Number 6, May 15-16, 1984. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1985) – Periodic Inspection Report Number 7, May 7-8, 1985. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1987) – Periodic Inspection Report Number 8, May 5-6, 1987. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (1989) – Periodic Inspection Report Number 9, May 16-17, 1989. 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.
- USACE (1999) – Periodic Inspection Report Number 11, May 4-5, 1999. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (2004) – Periodic Inspection Report Number 12, May 4-5, 2004. Gathright Dam & Lake Moomaw Project, Covington, VA.
- USACE (2009) – Instrumentation Report, February 2009, Gathright Dam & Lake Moomaw Project, Covington VA.
- USACE (2009) – Documentation for Screening for Gathright Dam, February 18, 2009.
- Virginia Public Service Company (1929) – General Geological Map of Gathright Development, October 1929.
- Virginia Public Service Company (1929) – Geological Map and Structural Sections in Vicinity of Dam Sites, October 1929.
- Photographic Interpretation Corporation (1979) – The Detection of Springs and Seeps at Lake Moomaw, Gathright Dam, Virginia, July 1979.
- Schnabel Engineering (2010) – Seepage Assessment Report – Gathright Dam, Covington, VA, January 2010, Prepared for the USACE Norfolk District.

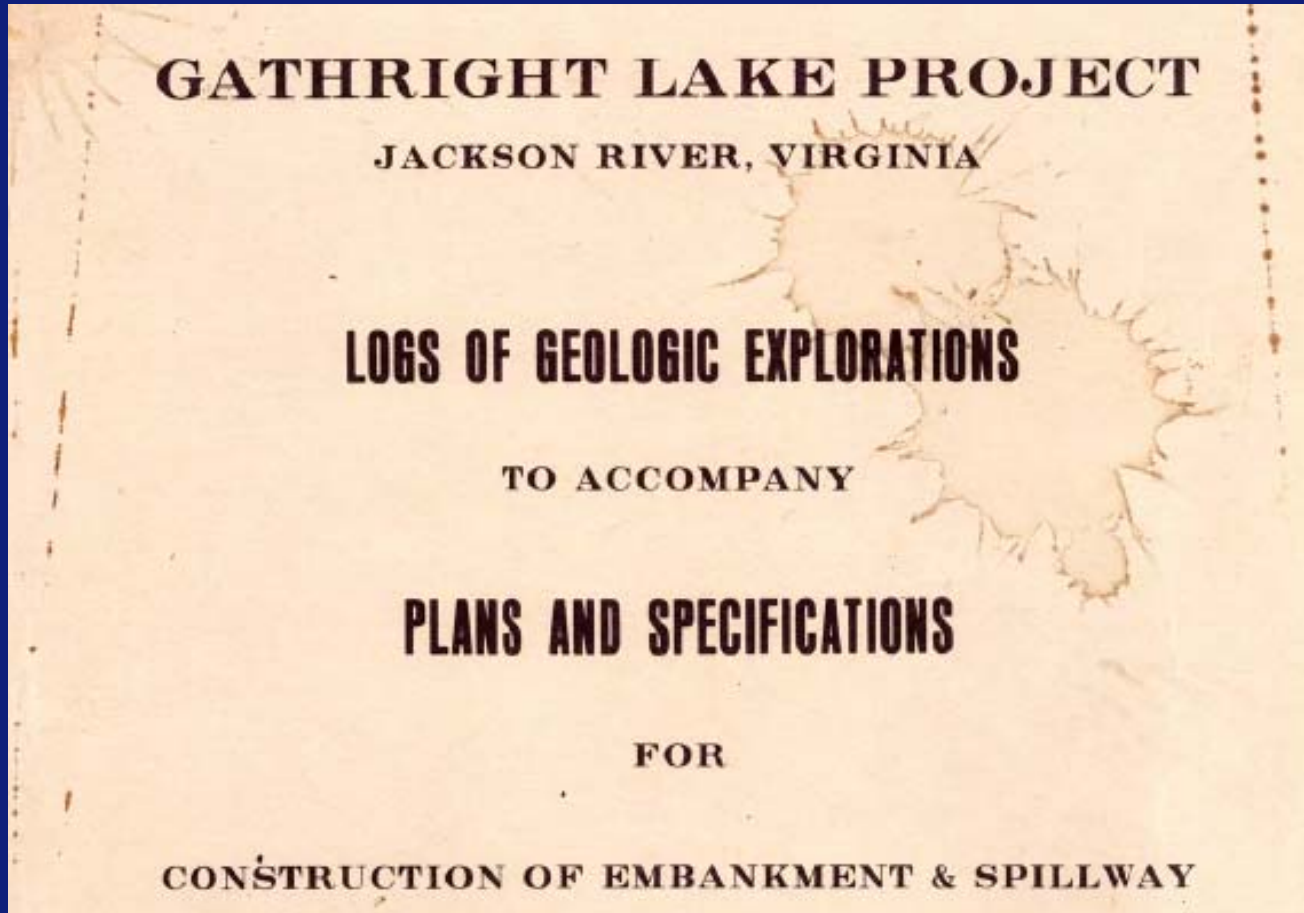
Site Visit - October 19 and 20, 2009



Overwater Geophysical Surveys

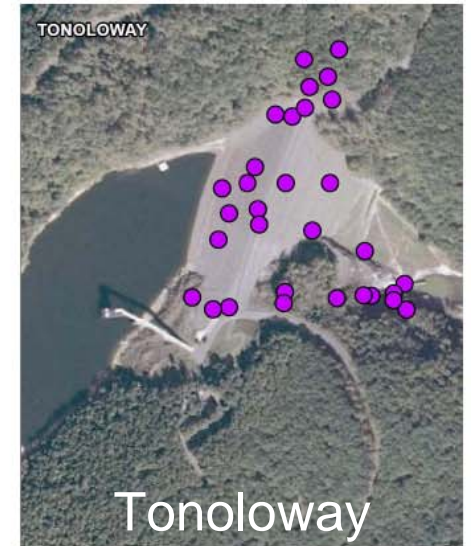
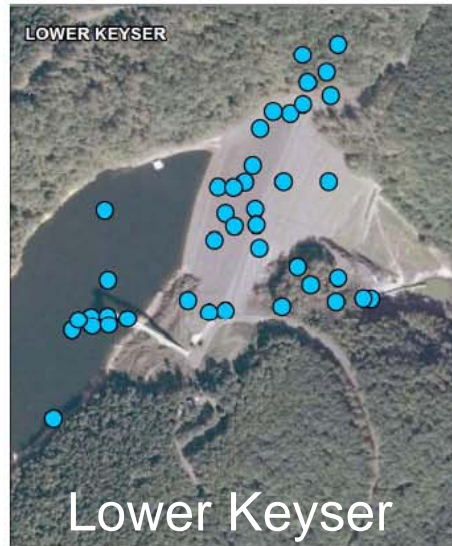
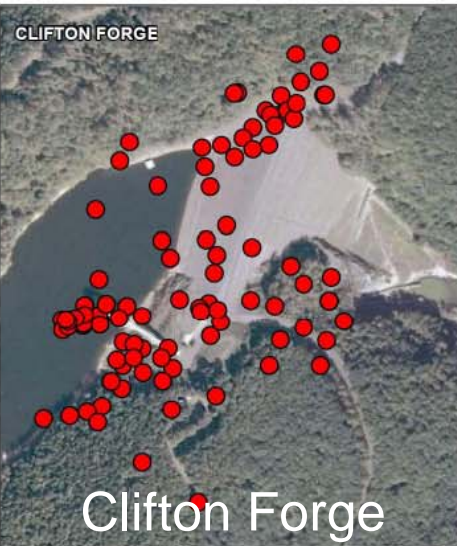
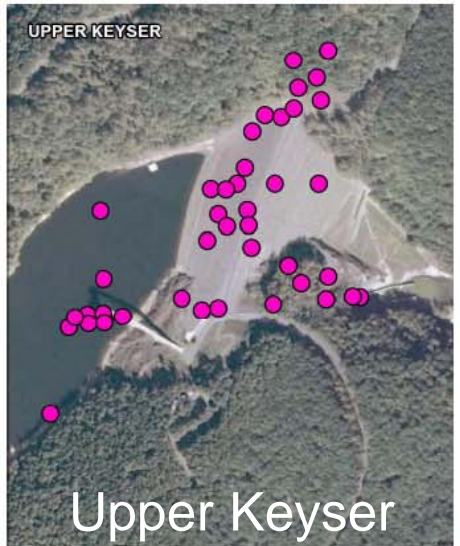
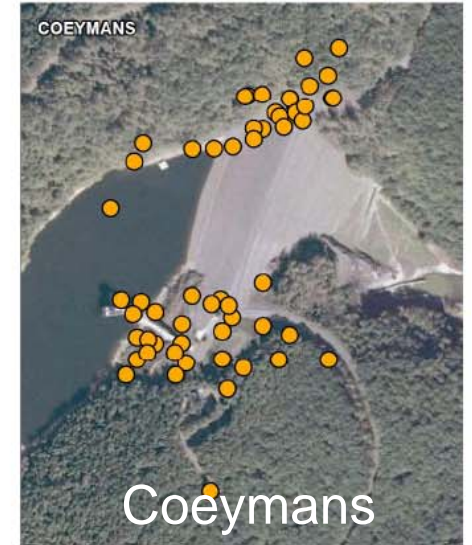
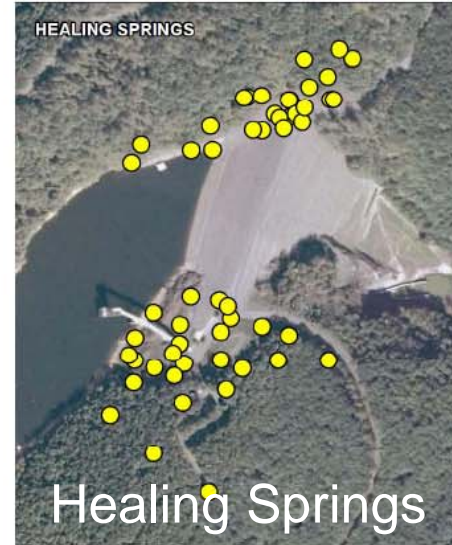


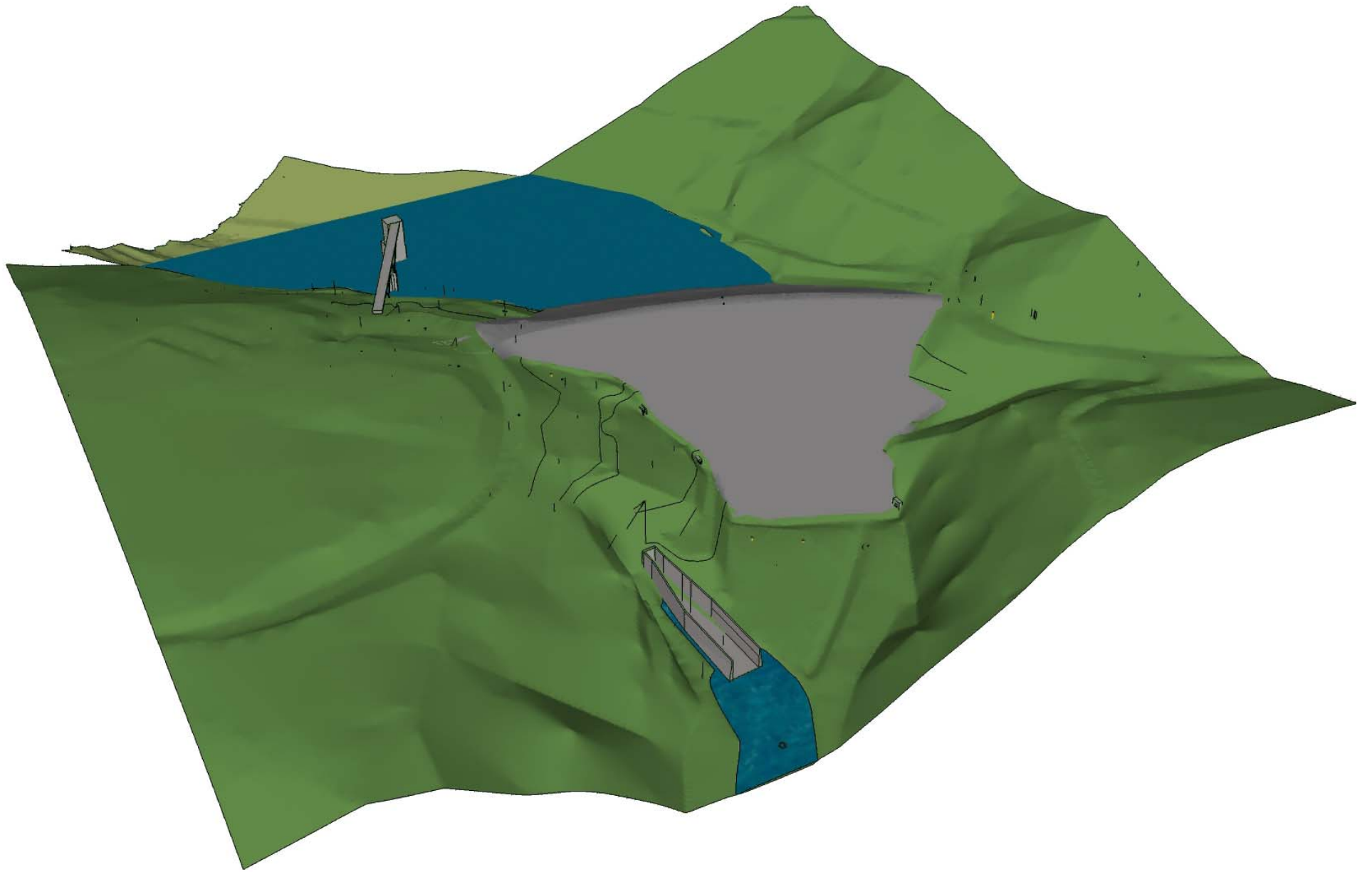
Data Digitization and Visualization



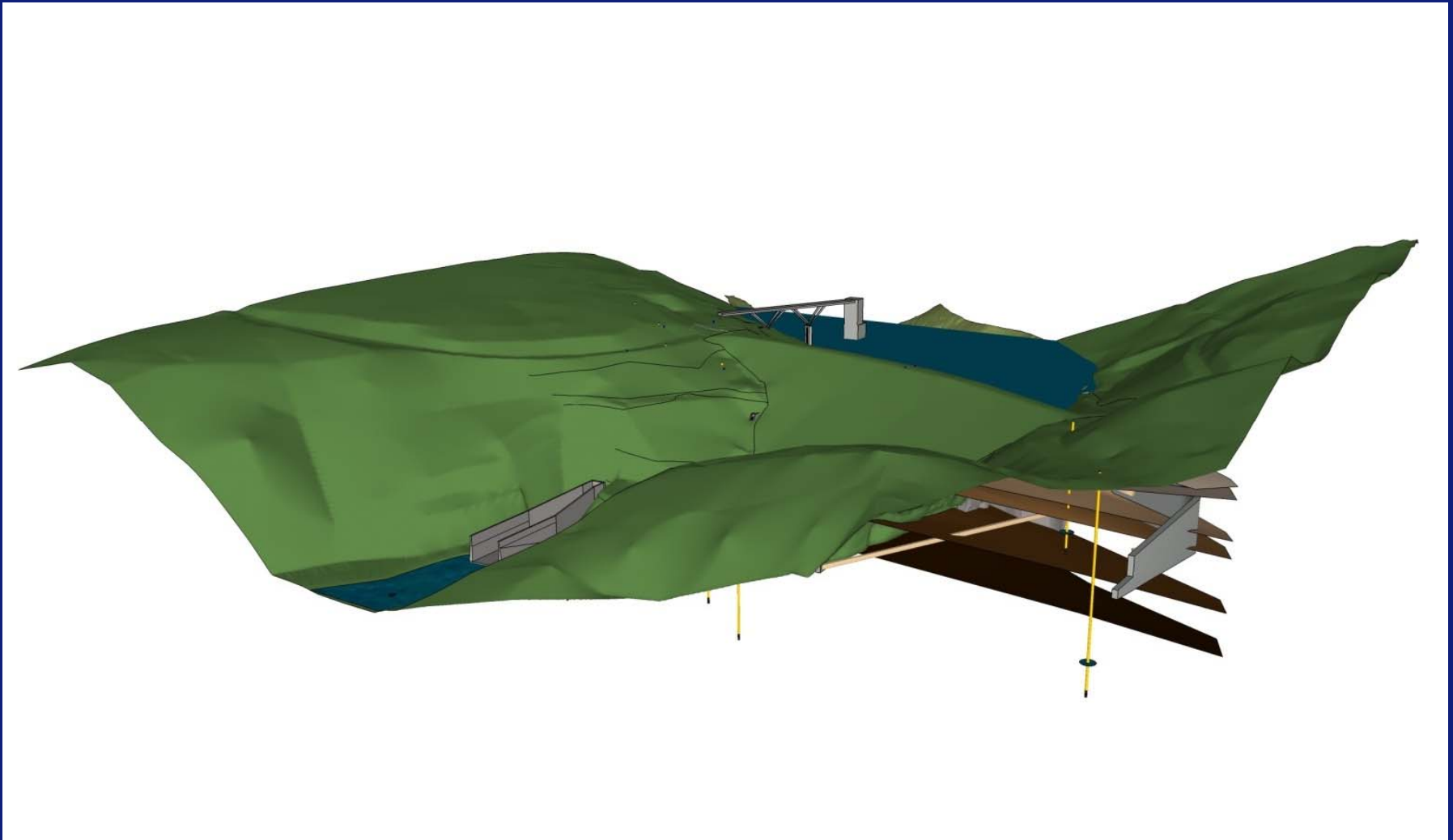
Geologic Database - Input

181 Borings

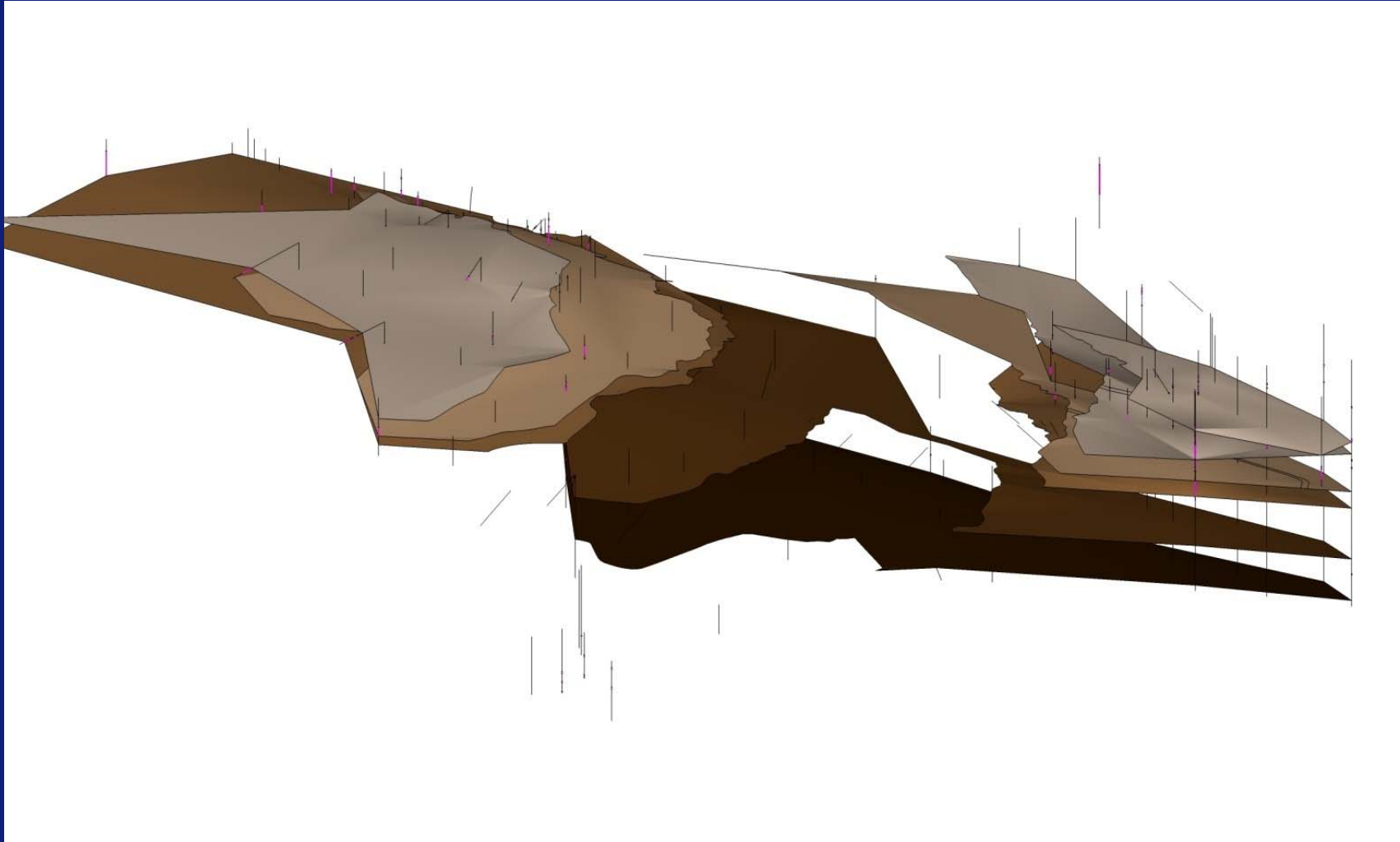




Data Digitization and Visualization



Data Digitization and Visualization



Voids!



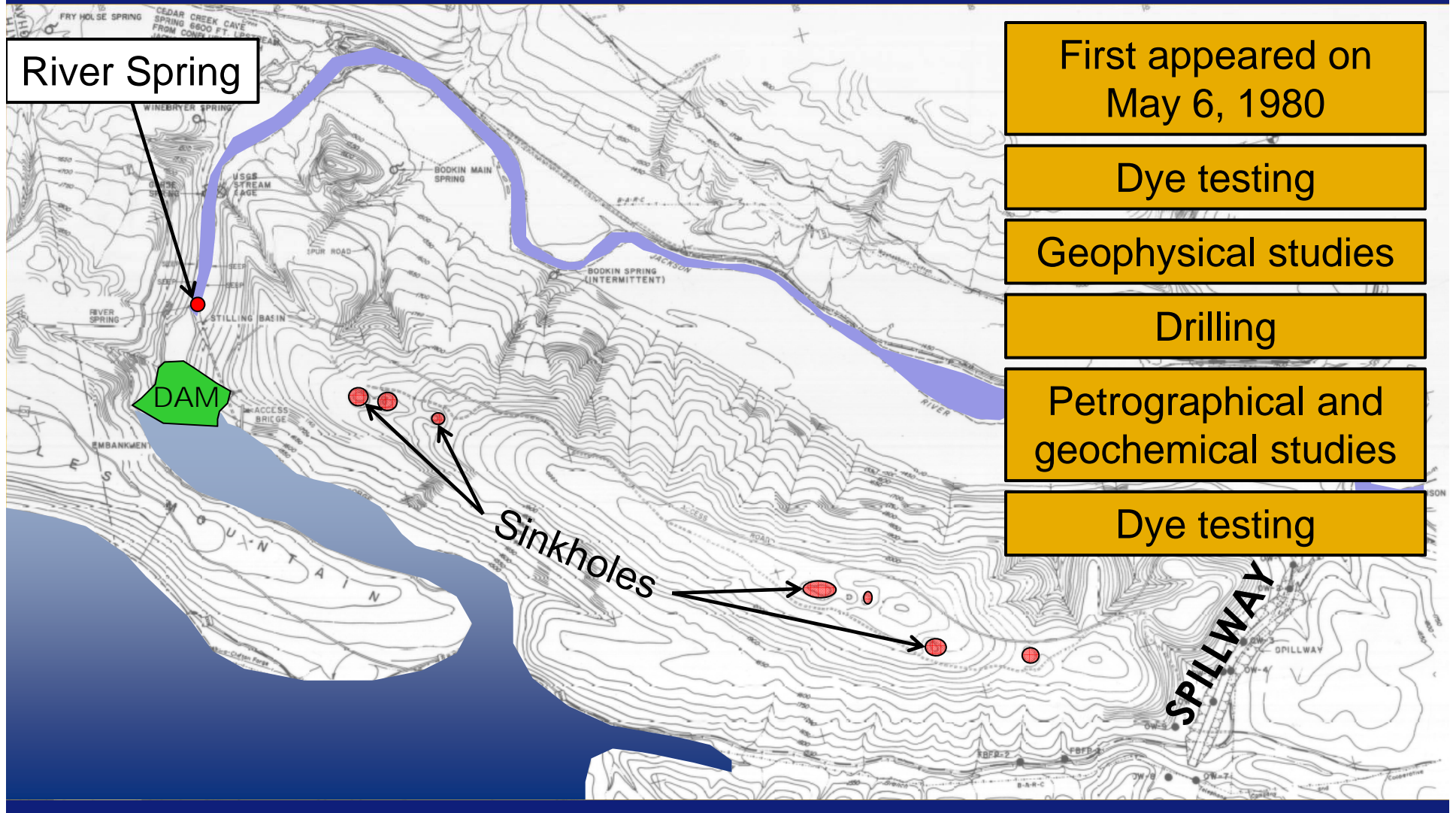
Geologic Database – Void Statistics

Formation	Number of Holes	Linear feet of drilling	Number of Voids	Linear feet of voids	Average	Percent
					Packer test per void	of voids
					Grout takes	
Licking Creek	52	3075	34	89	2.6	2.9%
Healing Springs	86	2599	36	157	4.4	6.1%
Coeymans	72	2815	120	1238	10.3	44.0%
Upper Keyser	72	1454	31	170	5.5	11.7%
Clifton Forge	108	5135	20	37	1.9	0.7%
Lower Keyser	42	1837	5	8	1.6	0.4%
Tonoloway	31	1554	12	31	2.6	2.0%

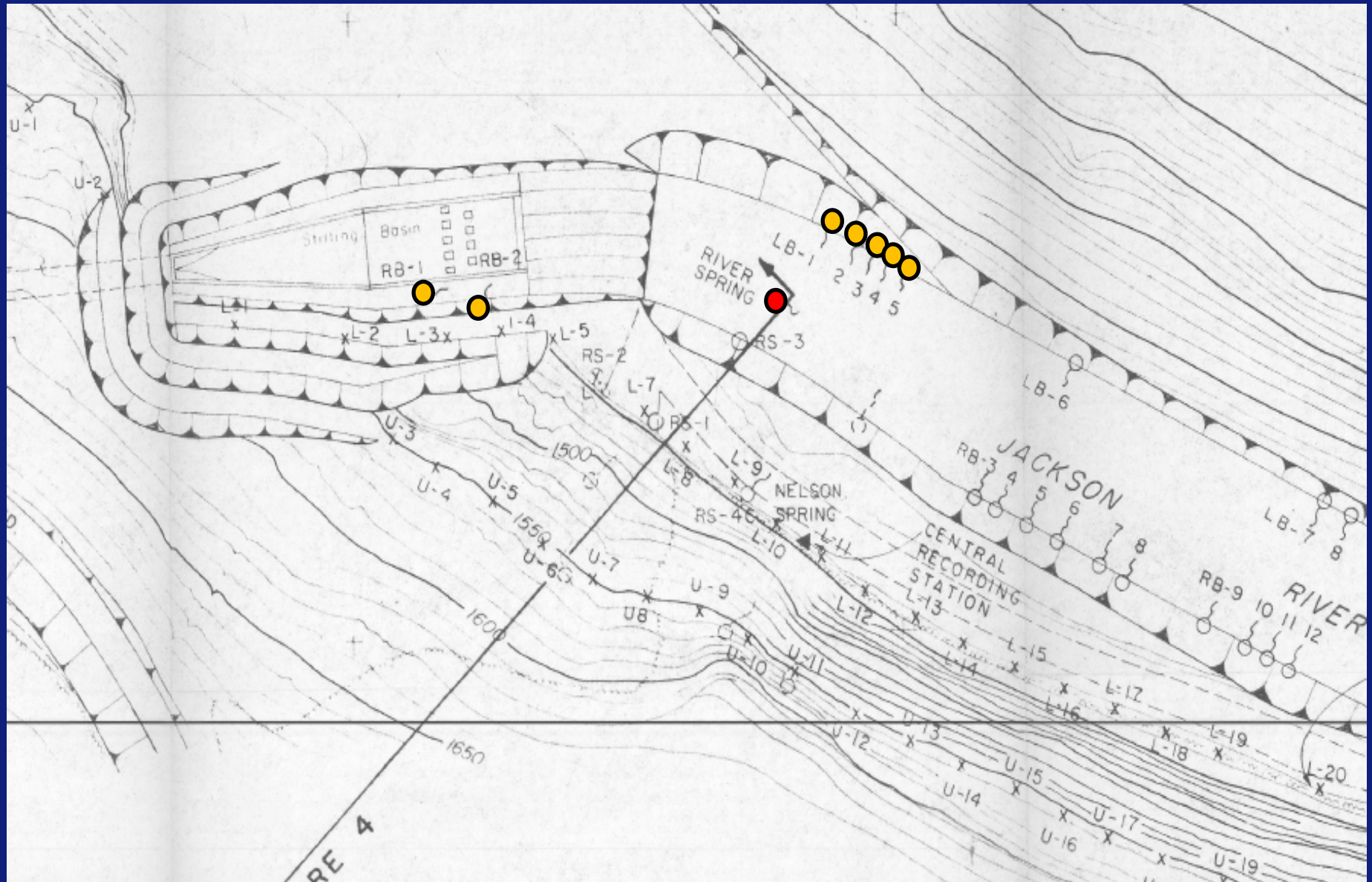
Our Primary Concerns

- 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

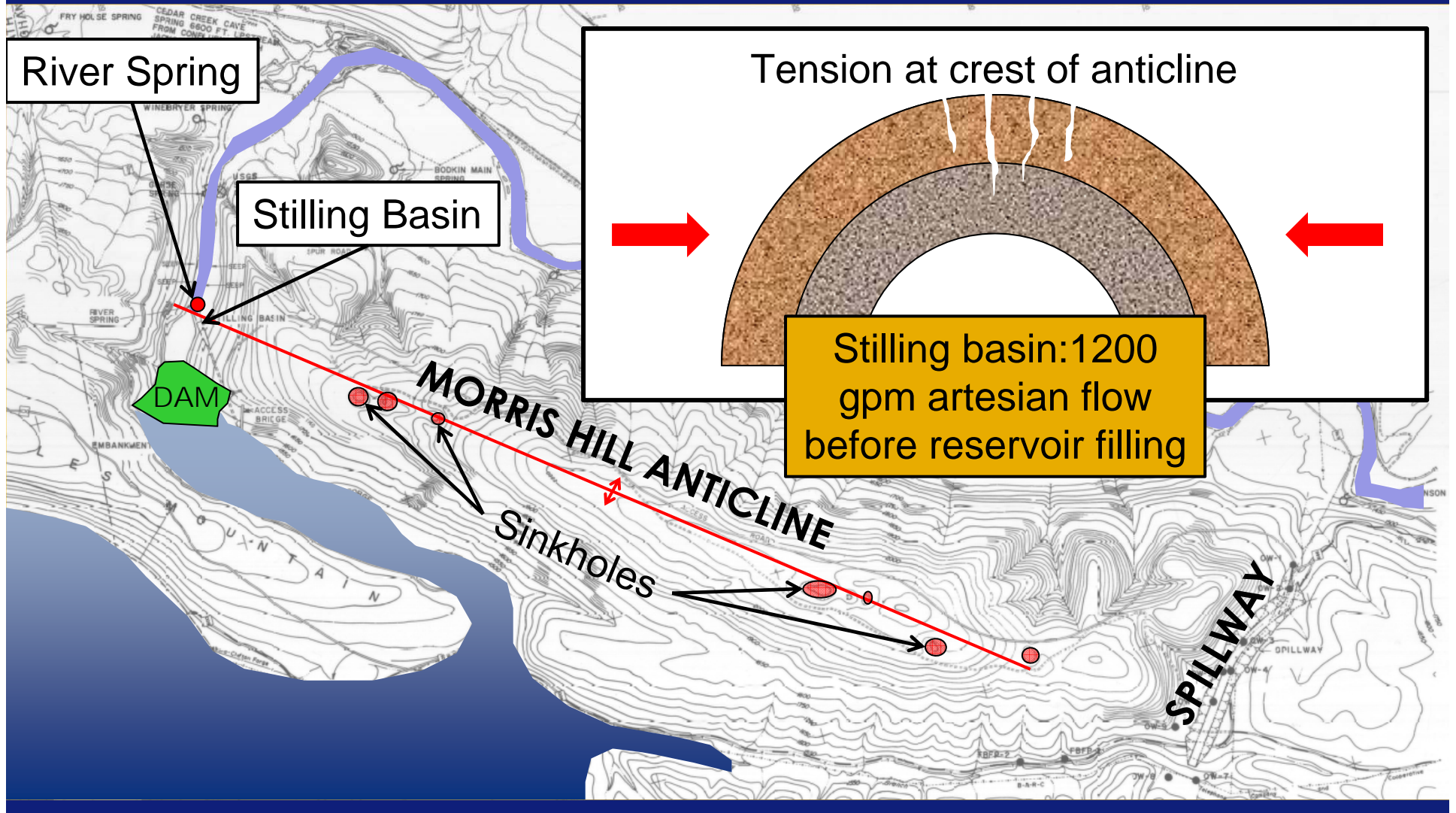
River Spring



Springs in Gorge



River Spring System



Summary of Findings

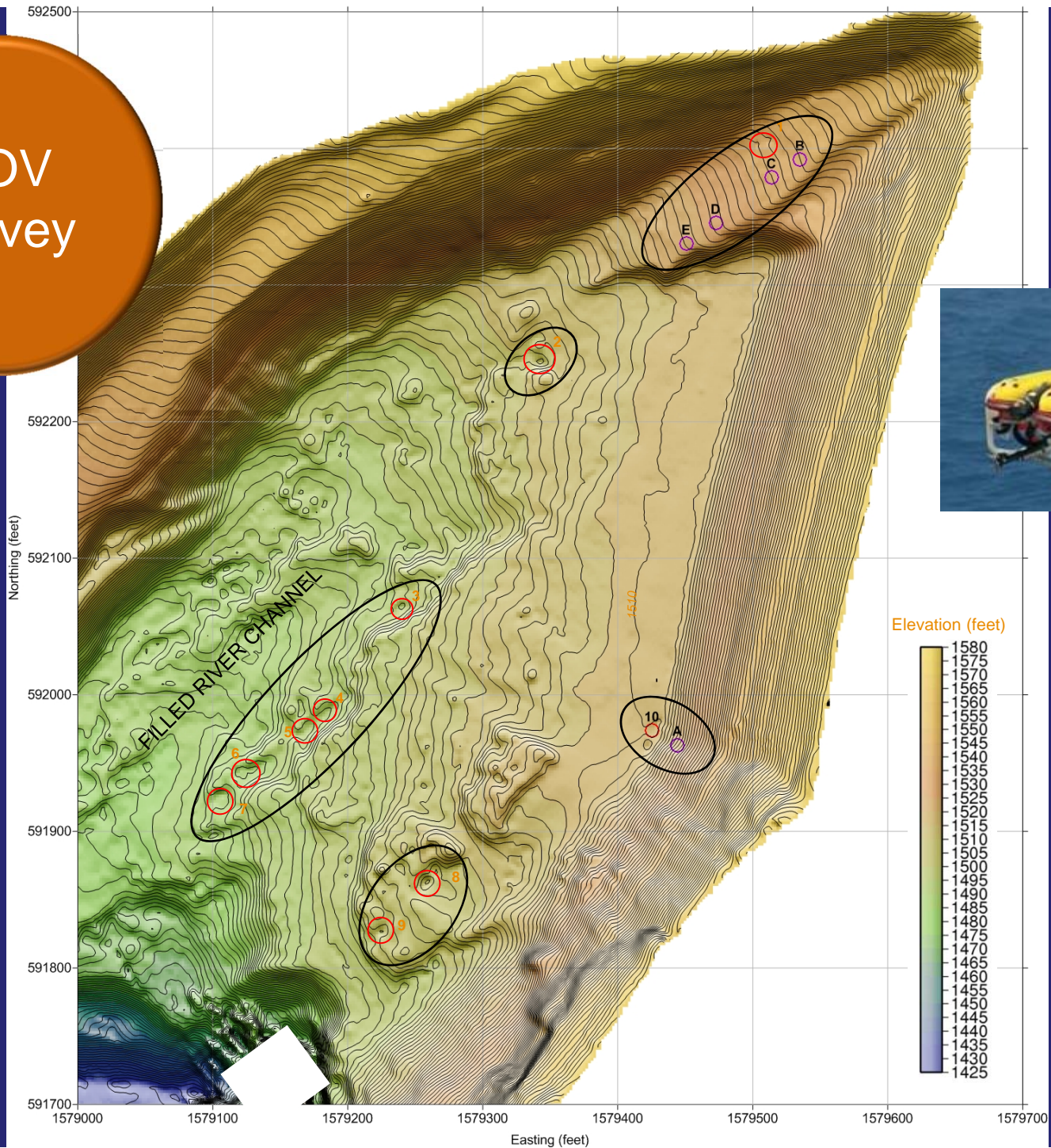
- River Spring System is primarily geologically controlled
- No evidence for direct connection of River Spring System with reservoir
- Seepage control features are performing as designed
- Cannot monitor performance of grout curtain beneath the dam
- Should monitor spring flows

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





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