

A SUSTAINABLE WATER PLAN

Dredge First – Dam Later

The “Community Water Supply Plan” is over-sized and over-priced. The fundamental assumptions that underpin that plan have been invalidated by new information.

Citizens of Charlottesville and Albemarle County Deserve Fact-Based Decisions. The facts demand we revisit the dredge-first plan NOW!

The following questions will help you understand how much things have changed since the dam-and-pipeline plan was developed. You will see what *they said* to justify the plan, and what *we now know* based on new studies and new information.

All of the new information and evidence supports a phased approach that maintains what we have by dredging the South Fork Rivanna Reservoir and upgrading the spillway of the Lower Ragged Mountain Dam. We will have abundant water for decades.

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1. How much water will the Urban Service Area need?

The Urban Service Area includes the City of Charlottesville, the University of Virginia, and the portion of the County surrounding City that gets water from the Albemarle County Service Authority. Both the City and the Albemarle County Service Authority buy water from the Rivanna Water and Sewer Authority (RWSA).

- **They Said:** In 2004, the Rivanna Water and Sewer Authority said the Urban Service Area will need 18.7 million gallons a day (mgd) by 2055 ([Source A](#), p. 13).
- **We Now Know:** The Urban Service Area uses 20% less water annually than we did in 2002, despite a 17% population increase – and the lower usage has been sustained ([Source B](#), p. 24).
- **We Now Know:** The most recent water demand study (2011) shows that even with high estimated population growth over the next 50 years, the Urban Service Area will need only 16.17 mgd by 2055 ([Source B](#), Table 19), and probably less. This study has been criticized as continuing to over-estimate future demand. Among other concerns, it does not adequately account for water savings that will occur because all new homes and new commercial buildings must comply with state building and plumbing codes, which mandate high-efficiency plumbing fixtures.
- **We Now Know:** Water conserving innovations continue to come on the market, but RWSA's 2011 water demand study gives little credit to future savings. The Federal government imposes water efficiency requirements as part of reducing use of energy (a lot of energy is used to make water clean enough to drink). As the cost of water rises, local government agencies, businesses, industries, and residents will continue to seek ways to use less water. In the Charlottesville-Albemarle area, many people voluntarily implement water conservation measures, even in the absence of incentives such as rebates. Both the City and the County – and even RWSA – have invested in water-savings technologies for new buildings and retrofits for some existing buildings.

2. How much water is available in the Urban Service Area?

- **They said:** RWSA will say there is less than 1,600 million gallons of useable water available to the Urban Service Area in case of drought. Useable water refers to the water in reservoirs that is above the level of intake pipes that are used to pull water from the reservoirs. The 1,600 million gallons RWSA refers to is made up of water in only three reservoirs:
 - 800 million gallons in the South Fork Rivanna Reservoir ([Source C](#), p. 1).
 - 463 million gallons in the Ragged Mountain Reservoir ([Source F](#), p. 36).
 - 324 million gallons in the Sugar Hollow Reservoir ([Source F](#), p. 36).
- **We now know:** There is considerably more than RWSA tells us is available to the Urban Service Area, including water from six reservoirs:
 - 988 million gallons in the South Fork Rivanna Reservoir ([Source E](#), p. 7, computed by subtracting 401 mg dead storage from 1,389 mg total storage). This is more than cited by RWSA, because HDR was required to adjust its survey

numbers to compare to an earlier, less accurate survey, which lowered the reported volume to 882 million gallons ([Source E](#), p. 8).

- 463 million gallons at the Ragged Mountain Reservoir.
- 324 at the Sugar Hollow Reservoir.
- Beaver Creek Reservoir, now that the 2011 water demand study determined the Crozet area's use in 2060 will be somewhat lower than previously estimated ([Source B](#), p. 55).
- Lake Albemarle has been considered for use in emergencies ([Source AA](#), p. 6).
- Chris Greene Lake has been considered for use in emergencies (partially available) ([Source AA](#), p. 6).
- **They said:** The 2002 bathymetric study, reported in 2004, estimated the sedimentation rate in the South Fork Rivanna was 15.14 million gallons per year ([Source C](#), p. 2) and predicted that South Fork's usable storage would decline to 200 million gallons by 2055 ([Source C](#), p. 4).
- **We now know:** The 2009 HDR study determined the usable volume at South Fork is in fact 988 million gallons and the sedimentation rate is only 7 million gallons per year – less than half the rate RWSA uses ([Source D](#), p. 4). This also means that without dredging, South Fork will still have 700 million gallons of water storage in 2055, more than three times the amount used to justify the dam-and-pipeline plan.

3. What is “safe yield”? How much safe yield is available in the whole water supply system for the Urban Service Area?

The concept of “safe yield” is important to understand to answer this question. Safe yield is a measure of how much water a system will produce and how much water can be withdrawn to withstand bad droughts. It is not the same as total volume of water. This is why it is misleading to focus only on how much water (or how many gallons) can be stored behind a dam. It is important to understand what makes a reservoir efficient or inefficient.

- **An efficient reservoir**, like South Fork Rivanna Reservoir, typically has a large watershed and some base flow from groundwater, even during dry spells. The Rivanna River above the South Fork Reservoir is a very efficient watershed. There is always some flow and it doesn't take much rainfall to fill South Fork back up.
- **An inefficient reservoir**, like the Ragged Mountain Reservoir (current or proposed), does not fill quickly. Any reservoir at Ragged Mountain is inefficient because it depends on water transferred from another watershed (currently, water is transferred from Sugar Hollow through a pipe designed to allow the water to flow downhill, without pumping). RWSA's ability to refill Ragged Mountain reservoir is limited by the size of the transfer pipe and the availability of water in the transfer source. The proposed large new dam at Ragged Mountain will need a 9.5 mile long pipeline to pump water uphill from South Fork Rivanna Reservoir.

So, how much safe yield is available? We don't really know the answer to this question, and that's one of the biggest problems.

RWSA uses a privately-owned computer model to determine safe yield. That means nobody really knows how the computer model works. It also means RWSA controls the inputs and the assumptions used to run the model. For example, it looks like the model has NOT been adjusted to use the results of the HDR dredging study, nor has it been adjusted to correct the original assumption that none of the water at Beaver Creek Reservoir will be available for the Urban Service Area. The new water demand estimate for Crozet indicates that nearly 1 million gallons per day from Beaver Creek is available to the Urban System in case of a drought because Crozet's projected demand is significantly less than previously thought. Water from Beaver Creek Reservoir can be released to flow downstream to the South Fork Rivanna Reservoir. This new information has not been factored into RWSA's safe yield estimates.

- **They said:** The RWSA contends that due to siltation at South Fork Rivanna Reservoir, the safe yield of the system will drop from 12.8 million gallons per day (mgd) today to 8.8 mgd by 2055 ([Source G](#), p. 3). RWSA continues to use 8.8 mgd safe yield to justify the new project, which means the dam-and-pipeline plan is equivalent to a deliberate decision to allow South Fork to fill up with silt.
- **We now know:** The HDR dredging feasibility study found more volume of water (i.e., less sediment) in South Fork than previously estimated and it is silting in much slower than previously thought. It appears RWSA has not accounted for this new information in any of the safe yield analyses, which means we don't have an accurate safe yield today, nor do we have a reasonable estimate of the safe yield in the future.
- **They said:** RWSA's Request for Permit Modification, submitted to the Virginia Department of Environmental Quality, indicates the safe yield of the urban system with the new large dam that raises the pool by 30 feet, but without the uphill pipeline, will be 12.5 mgd ([Source I](#), p. 3).
- **We Now Know:** Using RWSA's safe yield numbers, after the new large dam is built, but before the uphill pipeline is installed, we will have less drought security than we have today.
- **We Now Know:** Water released from Sugar Hollow flows down the Moormans River and on down to South Fork, as does water released from Beaver Creek reservoir and Lake Albemarle. Chris Greene Lake flows into the North Fork, also part of the Urban Service Area. We don't know if those contributions to the urban water supply are factored into the safe yield, even though estimates of safe yield available from them have been made, allowing for consumption in Crozet.
- **We Now Know:** Assuming no change in stream flow releases from Sugar Hollow, the DEQ determined the safe yield of dredging alone is 15.5 mgd ([Source J](#), Table 1). This is just 4% less than the 16.17 mgd that the latest study estimates we'll need in 2055. This is conclusive evidence that we have abundant water for decades, if we simply maintain what we have by dredging.

- **We Now Know:** Claims by the supporters of the large new dam that dredging would not comply with state requirements in the existing permit is misleading because those requirements would change if the new dam is dropped in favor of dredging. Dredging is a different way to achieve the same goal of drought security – the State would necessarily consider it independent of any previous plans and would require different stream flow releases.

4. How much will a large new earthen dam at Ragged Mountain cost?

- **They Said:** We’ve heard a variety of numbers on this one. Last April, the consultant designing the new dam provided a cost estimate for the 90% design stage– for just the new dam. That estimate shows a range of \$18.8 to \$22.3 million ([Source K](#)).
- **They Said:** The RWSA’s 5-year capital budget estimates the cost of just the new dam at \$38.5 million, including engineering services and construction ([Source L](#), p. 26).
- **We Now Know:** Supporters of the large new dam talk only about “the new dam” because then they can obscure the potential total cost of the dam-and-pipeline plan. They should be talking about the total cost because without the pipeline, the new dam can be filled only by water from Sugar Hollow and, importantly, any new water stored by the new dam cannot be distributed throughout the entire Urban Service Area. This means we have no additional drought protection for at least 20 years.
- **We Now Know:** The total cost of the new dam and pipeline, PLUS wetland and stream mitigation and I-64 embankment protection, will run to more than \$100 million (see next bullet under this question). Applying RWSA’s rules for financing capital projects, this will cost about \$6.6 million a year – for 30 years.
- **We Now Know:** Some of the most significant costs they don’t reveal include:
 - \$63 million for the 9.5-mile uphill pipeline (including a grossly underestimated \$1.3 million for easements, and not including any estimate of the annual operating cost, such as electricity to run the pump) ([Source M](#), p. 41). The 2010 Capital Improvement Plan includes a line item of \$2.295 million for right-of-way ([Source L](#), p. 26).
 - \$2.3 million to protect the I-64 embankment that will be inundated by the higher water level behind the large new Ragged Mountain dam ([Source L](#), p. 8).
 - \$3.4 million to pay for stream and wetlands mitigation ([Source L](#), p. 26).

5. What will happen to our water rates if the dam-and-pipeline project is built?

- **They Said:** The RWSA says – but hasn’t explained – that City and County water rates probably won’t go up for at least 5 years if the proposed dam is built. It’s important to understand that RWSA doesn’t plan to build the uphill pipeline for at least 20 years, so the costs associated with the pipeline aren’t factored into that 5-year projection.
- **We Now Know:** What they’re not discussing in public is what will happen to rates after 5 years. They never mention the additional millions of dollars in interest we will have to

pay and they refuse to provide even estimates of what the total cost of the proposed dam-and-pipeline will have on how much residents and businesses will pay for water.

- **We Now Know:** An RWSA internal email from 2006, obtained through a Freedom of Information Act request, estimates retail rates will go up 5-6 percent every year, perhaps for 20 years ([Source N](#)).
- **We Now Know:** Charlottesville used to have one of the lowest water rates in the state. Today, the City charges more for water than most Virginia cities, and our rates will go up even more if the dam-and-pipeline project is built.
- **We Now Know:** Water rates paid by all customers that get water from the Albemarle County Service Authority – including home and business owners in Crozet and Scottsville, each with separate water systems – will go up to pay for the dam-and-pipeline plan because the Albemarle County Service Authority charges all of its customers based on the same rate structure ([Source O](#)).

6. How much will dredging cost?

- **They Said:** During the 2004-05 planning process, RWSA said it would cost nearly \$145 million to dredge the South Fork Rivanna Reservoir ([Source G](#), p. 29), which meant the Federal and State regulators allowed them to take dredging off the table despite noting that “maintaining and expanding an existing element of the existing water supply system at equal cost and with minimal environmental impact, was preferable to constructing a new element” ([Source G](#), p. 68).
- **They Said:** In 2006, they estimated 5 million cubic yards of material would have to be removed from the South Fork Rivanna Reservoir by 2055 to restore its usable volume ([Source G](#), p. 27). The cost of dredging is highly dependent on the amount of deposited sand and silt to be removed.
- **They Said:** In 2007, RSWA upped the estimate for dredging to an astonishing +\$223 million, which prompted the infamous comparison to the cost of the Panama Canal. People in the dredging industry laugh at how our community has been misled about the complexity and cost of dredging.
- **We Now Know:** From the 2009 HDR study, only about 1.5 million cubic yards of material has been deposited, with only 748,000 cubic yards in the usable volume area ([Source D](#), p. 5).
- **We Now Know:** HDR estimated mid-range cost to dredge the South Fork Rivanna Reservoir (conservatively avoiding deposition around the water’s edge), considering the sale of sand and top soil, is \$29 million ([Source P](#)) given several restrictive limitations on method, timing, and disposal location. The RWSA’s early cost estimate to dredge is nearly 5 times higher than even the highest estimate developed by HDR in 2009. People in the dredging industry have indicated these limitations make HDR’s approach more costly than necessary.
- **We Now Know:** The RWSA is pursuing a new “performance-based” procurement method widely expected to produce a much lower cost because it allows contractors a lot of flexibility to propose different approaches to dredging, such as “small bites” over time, using smaller disposal sites, and selling recovered sand and topsoil to offset costs.

7. What would happen to our water rates if we dredge the South Fork now?

- **We Now Know:** Historically, RWSA's water rates charged to the City and Albemarle County Service Authority have been established to cover its operating costs and debt service on money borrowed to pay for capital projects. In 2003, water rates were increased beyond RWSA actual costs in order to pay for dredging and reservoir improvements. However, that work was never done. The RWSA has collected more than \$30 million because of that rate increase. Exactly what they've actually used it for is unclear. But it does mean that ratepayers are already being charged for dredging, which should mean rates won't go up if dredging is pursued.
- **We Now Know:** Even if RWSA has to borrow the whole amount to pay for dredging and upgrade of the existing Ragged Mountain dam spillway, the total cost for that work is in the range of \$35 million. And it is widely expected that the cost of dredging will go down considerably if RWSA uses the new procurement method described in the last bullet of the previous question. Applying RWSA's rules for financing capital projects, this could end up costing less than \$2.5 million a year. A "small bites" approach that does dredging over a longer period of time would likely cost even less, and maybe could be paid without going into debt.
- **We Now Know:** The RWSA's debt has been falling recently ([Source Q](#)). The less they borrow, the less pressure to raise our water rates.

8. How sound is the existing Lower Ragged Mountain Dam? What about the Sugar Hollow pipeline to Ragged Mountain?

- **They Said:** The RWSA used to say that the existing dam is unsound simply because it is old. Other supporters continue to make that claim, ignoring evidence to the contrary. Assuming that "old" is the same as "unsafe" is simply unfounded speculation. It is true that until last year, there were unanswered questions about the structural integrity of the existing dam.
- **We Now Know:** The only State requirement that must be met is to upgrade the spillway of the Lower Ragged Mountain dam to meet current safety standards. The City paid for a consultant to perform a thorough structural evaluation, including drilling into the concrete and running pressure tests. That evaluation determined the existing dam is solid enough to be successfully modified to meet current Virginia dam safety requirements and provide greater water storage ([Source R](#), p. 2).
- **They Said:** The RWSA claimed the cast iron pipeline from Sugar Hollow needs to be replaced and initially estimated it would cost \$12.87 million ([Source G](#), p. 41). In a subsequent public meeting and on radio, the RWSA executive director claimed the cost to completely replace this gravity-fed pipeline would be equivalent to the \$63 million price-tag for the 9.5-mile uphill pipeline from South Fork to Ragged Mountain. He subsequently retracted that characterization.
- **We Now Know:** In response to the City's request that the integrity of the pipeline from Sugar Hollow to Ragged Mountain be tested to back up the claim it needs to be replaced, RWSA said its consultant reported there are no methods to perform such a test. RWSA

spends an average of \$2000 per year for maintenance, hardly evidence that it is in failing condition.

9. Is a large new dam needed to improve environmental flows in the Moormans and South Fork Rivanna?

- **They Said:** As part of the justification for the dam-and-pipeline plan, the primary author (The Nature Conservancy) assumed a direct similarity between the Moormans River (a mountain stream) and the Mechums River (a valley river), using only a scaling factor based on drainage area ([Source S](#), p. 8), even though the flow characteristics of valley rivers are very different than those of mountain streams. There is no evidence that standard tests of hydrologic similarity were applied.
- **We Now Know:** The Nature Conservancy developed proposed environment stream flow releases based on that assumption of similarity between the watershed of the Moormans and the watershed of the Mechums. This means the “environmental flows” assigned to the Moormans actually will cause significantly higher flows and unnatural conditions during some periods of the year when the watershed above Sugar Hollow naturally goes dry.
- **We Now Know:** The RWSA could do more right away to improve streamflows in the Moormans. The RWSA has failed to comply with the DEQ permit requirement to upgrade the release pipe within two years after permit issuance to allow greater control and to increase the amount of water that can be released ([Source S](#), p. 14). This release pipe upgrade was supposed to have been completed by February 2010. Plans to install gages on the Moormans were also abandoned.
- **We Now Know:** Because we use 20% less water than we did 10 years ago, there is more water available for our rivers.

10. Why do they want to build a new dam now, decades before we need more water?

- **They Said:** Some of the reasons given include the 2002 drought experience; the value of improving flows in the Moormans River; and because of the economy, the cost of construction will be lower.
- **They Said:** They want us to believe we came close to running out of water in the 2002 drought. However, an RWSA consultant reported in October of that year that there was “approximately 136 days of water supply remaining” if citizens continued to keep usage low ([Source T](#), p. 1).
- **We Now Know:** If our current system has sufficient water for decades, then we certainly don’t need to go into debt today by over-building a new large dam. It does make sense to maintain what we have by starting to dredge the South Fork Rivanna Reservoir.
- **We Now Know:** The phased approach approved by City Council in September 2010 would rely on dredging and raising the existing concrete dam at Ragged Mountain enough to add 13 feet to the water depth ([Source U](#), p. 2). This would not only address the undersized emergency spillway, it would increase drought protection for years to

come. This approach would also mean that today's ratepayers would not be burdened with paying millions for infrastructure that isn't needed for decades.

- **We Now Know:** In August 2010, the DEQ evaluated the September 2010 phased approach and determined it would increase safe yield to 16.8 million gallons per day (mgd) – even with the stream flows associated with the new large dam taken into account, referred to as “permitted” operating conditions ([Source J](#), Table 1). As noted under Question #1, the most recent water demand study estimates the Urban Service Area might need in 16.17 mgd by 2055 (and 16.96 mgd by 2060). The DEQ's evaluation makes it clear that we have abundant water for nearly 50 years. And given the water-saving technology advances anticipated in the coming decades, it is reasonable to expect that the average amount of water used by each person in our community will continue to fall.
- **We Now Know:** Three City councilors changed their minds and by a 3-2 vote, in January 2011, overturned the logical, incremental approach in favor of a large earthen dam, with an initial phase to raise the Ragged Mountain reservoir by 30 ft ([Source V](#), p. 2). Until the pipeline is built in 20 years, this scenario has almost the same safe yield as the current system ([Source I](#), p. 3). Building a new dam does not increase our drought security.

11. What City resources will be lost or altered if the new dam is built?

- **They Said:** Actually, the dam supporters never mention that the dam-and-pipeline plan requires the City to give up a lot of resources. And because the cost-share negotiations between the City and Albemarle County Service Authority are closed to the public, we have no way of knowing if the true value of the City's lost and altered resources is somehow taken into account as part of those negotiations.
- **They Said:** The abandonment of the South Fork Rivanna Reservoir to siltation is written into the plan for the dam-and-pipeline project. In a memo to City Council, RWSA states that "...about one-third of the new water storage proposed at Ragged Mountain is to replace storage expected to be lost at South Fork in the next 50 years..." ([Source W](#), p. 2)
- **We Now Know:** The 2003 cost -share agreement documents City ownership of 65% of the safe yield of the urban system ([Source X](#), p. 4). The capacity at South Fork is major element of the urban system. But the dam-and-pipeline plan assumes that the South Fork Rivanna Reservoir will silt in over the coming decades. That means both the City and the Albemarle County Service Authority stand to lose almost half their respective water if South Fork is abandoned in this manner.
- **We Now Know:** The City owns Ragged Mountain Natural Area where 200 acres of mature hardwood forest will have to be clear cut to make way for the large new dam and to allow for expansion of the lake surface. Nobody has told us of the ecological value of that much lost forest. For just the +30 pool raise, the lake surface will expand by 113 acres ([Source Y](#), derived by subtracting the “normal pool surface area” for the existing dam (55 acres, p. 10 of the pdf) from the “normal pool surface area” for the proposed dam (168 acres, p. 4 of pdf).

- **We Now Know:** Under the dam-and-pipeline plan, we will no longer have direct access to the water stored at Sugar Hollow. It is the cleanest and best water in the entire water supply system. The Department of Health noted it is “an excellent raw water source and the Department would encourage its maximum utilization” ([Source Z](#), p. 1). It is more expensive to treat water taken from the South Fork Rivanna Reservoir than it costs to treat water from Sugar Hollow, due to the need to filter the suspended clay and the silt out of the water.
- **We Now Know:** The County’s water resources, including water in the reservoirs at Beaver Creek, Lake Albemarle, and Chris Greene Lake, are not counted in RWSA’s calculations for the Urban Service Area, even though water from those sources would be available to augment the Urban Water System, as documented in RWSA’s Drought Management Plan ([Source AA](#), pages 5-6).

12. *Links to Cited Sources*

Source A: Demand Analysis for the Urban Service Area (2004).

<http://www.rivanna.org/documents/community/demandanalysis.pdf>

Source B: RWSA Regional Water Demand Forecasts (2011).

http://www.rivanna.org/documents/waterproject/regional_forecasts.pdf

Source C: Gannett Fleming Memorandum (2004).

http://www.rivanna.org/documents/community/comm_nov18_04/community_memorandum_nov18.pdf

Source D: SFRR Dredging Feasibility Study: Dredging Alternatives Report (2010).

http://www.rivanna.org/documents/sfrredredging/report_alternatives.pdf

Source E: SFRR Dredging Feasibility Study: Bathymetric Survey & Volume Analysis Report (2010).

http://www.rivanna.org/documents/sfrredredging/RivannaBathymetricSurveyVolumeAnalysisReport02_17_10.pdf

Source F: Safe Yield Study (2004).

http://www.rivanna.org/documents/community/comments_files/SafeYieldStudy.pdf

Source G: Permit Support Document for DEQ/COE Permits (2006).

<http://www.rivanna.org/documents/community/permitsupportdocument.pdf>

Source I: RWSA Request for Permit Modifications (2011).

<http://www.rivanna.org/documents/community/permitrequest.pdf>

Source J: DEQ Letter to Norris, Mallek (2010).

http://www.cvillewater.info/DEQ_letter_Norris_2010.pdf

Source K: 90% Design Opinion of Cost (April 2011).

<http://www.rivanna.org/raggedmountain/index.htm>

Source L: RWSA Capital Improvement Plan (2010).

http://www.rivanna.org/documents/report_capitalimprovementplan.pdf

Source M: Review of Proposed Pipeline from SFRR to Ragged Mountain (2010).
http://www.rivanna.org/documents/community/report_pipeline.pdf

Source N: RWSA email to selected board members (2006)
http://cvillewater.info/2006_rate%20increase%20with%20plan.pdf

Source O: Albemarle County Service Authority Water and Sewer Rates (2011).
<http://www.acsanet.com/publicnotice/RatesEffective.pdf>

Source P: HDR Report Supplement, annotated to highlight the “mid-range” cost estimates (2011).
http://cvillewater.info/HDR_supplement.pdf

Source Q: Estimated Future Debt Service for Community Water Supply Plan Scenarios (2010; based on data provided by RWSA). http://cvillewater.info/cost_debt.html

Source R: Feasibility of Modifying the Lower Ragged Mountain Dam (2010).
http://www.cvillewater.info/resources/B&V/Summary_B&V%207-30-10.pdf

Source S: DEQ Permit Number 06-1574 (2008).
http://www.rivanna.org/documents/community/DEQ_Permit_Document.pdf

Source T: O’Brien & Gere to RWSA, Emergency Water Supply Report (2002).
<http://cvillewater.info/2002%20drought%20report%20-%20highlighted.pdf>

Source U: City Council’s Resolution (September, 2010).
http://cvillewater.info/10_Sept20_CityCouncil_Water%20Supply%20Res_Original.pdf

Source V: City Council’s Resolution (January, 2011).
http://cvillewater.info/2011_Jan18_CityCouncil_Water%20Supply%20Res_Amendment.pdf

Source W: RWSA memorandum (2007).
<http://www.cvillewater.info/Frederick%20memo.Nov%2019%20public%20hearing.pdf>

Source X: 2003 Cost Share Agreement.
http://cvillewater.info/2003_Urban_Wate_%20Cost_Allocation_SFWTP.pdf

Source Y: Application for DCR Dam Safety permit to construct the dam (2011).
http://www.rivanna.org/documents/raggedmountain/permit_request.pdf

Source Z: Department of Health to RWSA (2002).
<http://www.cvillewater.info/DOH%20support%20for%20using%20Moormans%20River.pdf>

Source AA: Drought Response and Contingency Plan (2008).
http://www.rivanna.org/documents/rpt_drought.pdf