Are we overestimating our future water needs?
— an *updated* inquiry into data and assumptions —

There has been a renewed debate lately regarding how Charlottesville should best satisfy its future water needs. People of various perspectives are raising sensible questions and making sincere points. But while almost all the discussion has been about alternatives for developing a greater *supply* (with recent exceptions), there has been a conspicuous lack of serious attention to figuring out how to manage the *demand* side of the water equation. How much more water do we actually need?

Since 2004, all water supply analyses and discussions have been based on a 14-page document entitled "Demand Analysis for the Urban Service Area" prepared by Gannett Fleming. The purpose of the report was to give us an indication of how much more water we would likely be using in the future. The analysis essentially consisted of averaging various projections of future demand based on either historical water usage or anticipated population growth. The report concluded that the projected water demand is 14.5 MGD[1] for the year 2025 and 18.7 MGD for the year 2055.

Although these numbers are invoked as if they had been exactly computed and not subject to scrutiny, they are simply one firm's educated guesses based on various assumptions ... and some of the assumptions in the analysis are dubious and don't seem to reflect this community's priorities.

Drought Response is Significant ... but Disregarded
During the worst of the 2002 drought, the response of our community provided a very reliable indication of how significantly demand could be reduced during an emergency. The short answer is ... about 20%. Many people and businesses were certainly inconvenienced during this period but we know that, when pressed, we can – as a community – use quite a bit less water for a while and survive unscathed.

However, the Gannett Fleming analysis assumes that we could not – or would not want to be bothered to – reduce our water use during the *next* extreme drought; the firm defers to standard water supply guidance which recommends that drought response not be considered in water supply planning. Some would correctly argue that this assumption lowers the risk of an actual water shortage by providing a factor of safety ... but at what expense? What exactly is the marginal cost (in millions of gallons of storage or millions of dollars) of not having to be inconvenienced during subsequent droughts?

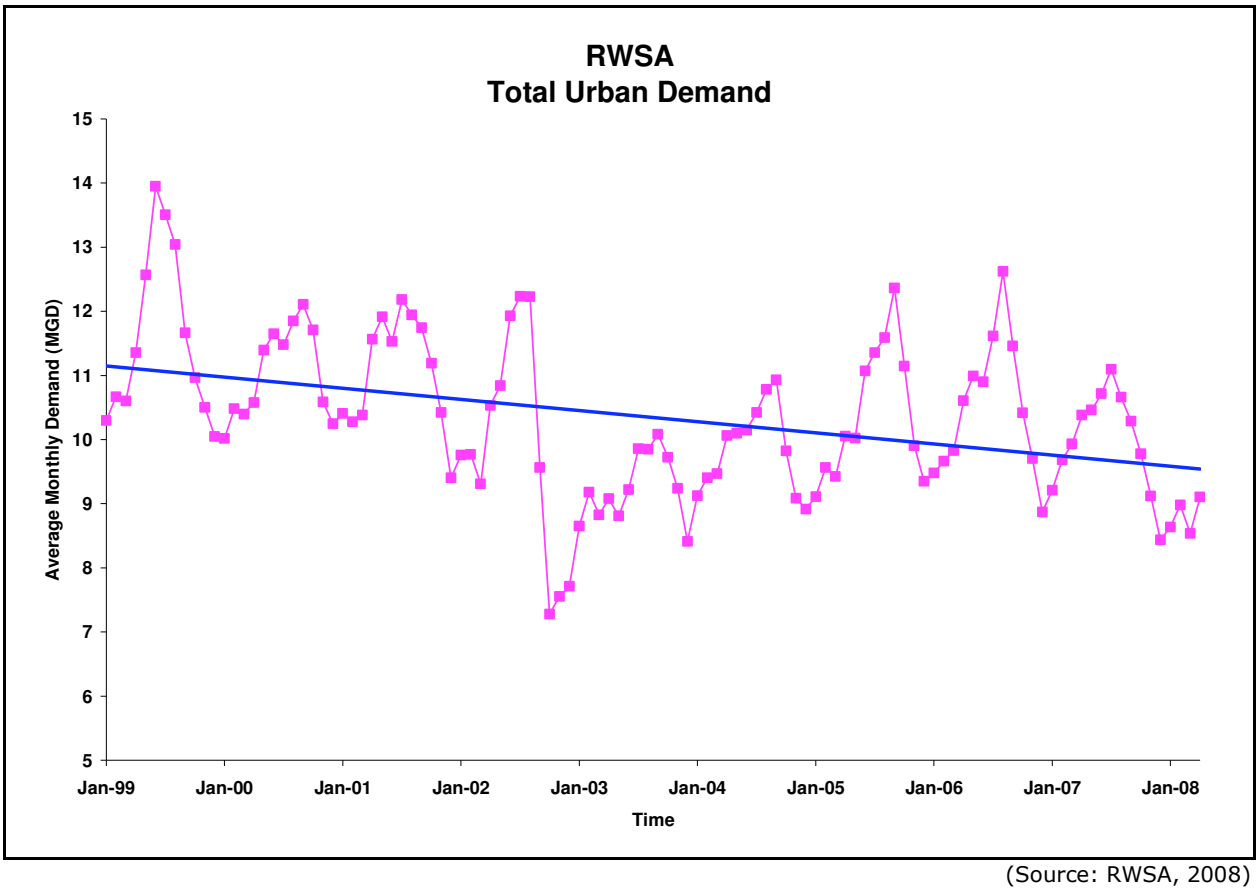
Water Conservation
While drought response is a short-term reaction to an extreme event, water conservation initiatives are more enduring. *Natural* conservation occurs over time due to, for instance, the replacement of older, less efficient appliances and fixtures with newer devices in homes and commercial buildings. *Active* conservation can occur as a result of public education, conservation rate structures, water restrictions, repairing leaky distribution systems, and other deliberate activities. The Gannett Fleming report notes that natural conservation typically results in a reduction of 4 to 8% over a period of 40 years and that active conservation can result in a reduction of 5 to 10%. Mathematically combined, these would result in a total reduction in water use in typical communities of between 8.8 and 17.2%.

But, as an additional factor of safety, we choose to believe that Charlottesville could only muster a measly 5% reduction over 50 years. Moreover, since the 18.7 MGD projection is actually rounded up from 18.61 MGD (presumably, to be even safer), we actually give ourselves credit for only a 4.5% reduction due to water conservation. This is about half of

the lower end of the range of what any other community in America could be expected to achieve. For context, a 2003 report[2] by the Pacific Institute indicates that California, already a leader in water conservation, could reduce its current urban water use by another 33% using existing technologies. Most locals would agree that, as environmentally-conscious as Charlottesville is, we can do better than 4.5% ... and because of our existing conservation initiatives, we might have already done so.

A Drop in Demand

Since water use during and immediately following the drought was so low, Gannett Fleming chose to disregard data from these years and, instead, assume that water use would soon rebound to "normal" levels and then continue to rise. This hasn't exactly happened. Either the drought served to instill in people's minds a permanent sense of resource stewardship or the natural and active water conservation measures promoted since the drought have overcome any increase in the number of users. Regardless of why, overall water demand – while fluctuating seasonally – has declined over the last decade. A linear trend line of RWSA[3] monthly data indicates that, on average, demand has been dropping 0.174 MGD per year (see chart below).



(Source: RWSA, 2008)

Much of the decline can probably be attributed to the water use restrictions that were mandated during the severe 2002 drought and restrictions during the relatively minor drought last year. *Unrestricted* peak summer demand appears to have not significantly changed over the record. What's interesting, however, is the decline in off-peak demand. During the three winters prior to the drought (1999 – 2001), demand was about 10 – 10.5 MGD; after the drought, winter demand dropped to between 9 and 9.5 MGD. These numbers, not influenced by restrictions, indicate that *base* use by unfettered citizens has

been reset downward, albeit modestly (10%). While base use doesn't represent total water demand, it's a major component of total demand and, thus, greatly influences this number.

Seasonal Variation in Water Use

Every year the demand for water bottoms out in mid-winter and peaks in late summer. Peak water use, unfortunately, coincides with the lowest seasonal stream flow (and, thus, storage) because so much water in the watershed is lost to evapo-transpiration. Similar to how big-box parking lots are designed for the busiest shopping day of the year, water supply systems are expected to meet water needs when demand is greatest and supply is leanest. While this appears to be a conundrum, perhaps it's not as bad as it seems.

The RWSA data indicate that recent unrestricted *peak* monthly averages are roughly 40% higher than the *minimum* monthly averages (what I referred to above as *base* use): specifically, 12.5 MGD in the summer versus 9 MGD in the winter. Clearly, a significant amount of water demand is discretionary — likely used for outdoor purposes like watering lawns and gardens, washing cars, filling pools, cleaning, and playing. These are activities that we *want* to do but don't necessarily *have* to do. The lowest seasonal averages are a more truthful indication of our community's basic water needs, or the amount of water that allows us to drink, cook, bathe, flush, clean our houses, and wash our clothes.

What if we planned for our basic needs and not our discretionary needs, too? While no one wants to refrain from using water for outdoor and other discretionary purposes, this would be necessary only during droughts (and occurs even now). In fairness, if the future water supply target capacity is decreased, water restrictions would be more frequent. But it seems that Charlottesville would prefer to plan for what is actually needed rather than build a bigger, more expensive system so we wouldn't have to be bothered with conserving.

While the demand analysis predicted that we would be using an annual average of approximately 12.2 MGD last year, the RWSA data indicate that, during the 2007 calendar year, the average use was actually about 10 MGD — 20% less than projected (the highest annual average demand since the drought was 10.5 MGD in 2006). While conclusions cannot be drawn from this one statistic (especially because summer water restrictions were in place), it seems that we are already diverging from the projected demand.

An Alternative 2055 Projection

We should be willing to take on a greater commitment to using water economically and insist on a more realistic future water demand target. At the risk of being criticized as reckless or idealistic, I propose beginning a conversation based on the following rough calculation.

We should start with the 2055 estimate (without conservation) of 19.59 MGD and then subtract a percentage that reflects an honest, but reasonable, commitment to conservation, say 15%, slightly less than the upper end of what has been observed nationally. That leaves 16.65 MGD. Next we trim off the luxury of business-as-usual discretionary use: this could be estimated as either 20% of the normal demand based on past community response or my observed percent difference between average annual use and base use[4], 12%. The latter is less so I'll use that value. Therefore, I offer as an initial alternative projection 14.7 MGD for the year 2055 (for context, the safe yield of the water system, as determined in 2005, was 12.8 MGD[5]). This projection assumes the same population growth as the Gannett Fleming report but is based on a belief that water conservation should play a more significant role in the water supply plan and a recognition that citizens will be willing to (once again) use less water during droughts. Who is to say that these assumptions are any less legitimate than those resulting in a projection of 18.7 MGD?

A Soft Path

It seems that the focus of the planning process has been on finding and developing yet another water supply through expanding our large, centralized infrastructure. This *hard path* often concludes with new engineering monuments of concrete and steel. But it's never too late to adapt our approach to be more integrated, sustainable, and effective — towards a soft path[6]. I'm not suggesting that we can absolutely get by without raising a dam or building a pipeline, but incorporating the following elements into water supply planning will likely save the community money and result in less environmental degradation:

1. be certain that the real objective is meeting the community's water needs and not just supplying more water
2. recognize that ecological systems would benefit most by lower total water demand, not a mitigation process[7]
3. make substantial investments in water conservation – it's almost always cheaper than developing new water supplies[8,9]
4. allow and facilitate the use of rainwater, stormwater, or grey water for certain water needs
5. keep in mind that natural, forested areas and good land management practices serve to protect the quality of our water supply, slow the rate of storage loss in reservoirs, and better recharge groundwater (thus resulting in more "free" storage) and, so, provide more incentives for these

As Charlottesville continues to enthusiastically embrace sustainability in every other aspect of life, let's not miss the chance to "green up" our water supply plan.

Note: Although I am employed as Water Resources Manager for Albemarle County, the views presented in this paper are mine and don't represent any official position of the County. I don't intend to imply that any numbers or ideas presented here are conclusive and offer them only for the purpose of adding to a conversation about a larger role for conservation and drought response in our water supply planning process. This version of the report reflects corrected data issued by RWSA. Greg

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[1] MGD = million gallons per day

[2] Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute. November 2003. Online at http://www.pacinst.org/reports/urban_usage/.

[3] RWSA = Rivanna Water and Sewer Authority

[4] For the last several years our base demand (9 MGD) has been about 12% less than the average annual demand (10.2 MGD); this suggests that if the supply target has been calculated to meet average demand, we could trim off 12% and still have enough to meet our basic needs during droughts.

[5] Charlottesville Tomorrow blog (http://cvilletomorrow.typepad.com/) quoting Tom Frederick, Executive Director of the RWSA.

[6] The *soft path*, as described by Peter Gleick and colleagues at the Pacific Institute, is a comprehensive approach to water management, planning, and use. Online at http://www.pacinst.org/topics/water_and_sustainability/soft_path/index.htm.

[7] The author acknowledges the benefit to the ecological health of the Moorman's River achieved by eliminating withdrawals from the Sugar Hollow Reservoir, an element of the current plan.

[8] Thinking Beyond Pipes and Pumps: Top 10 Ways Communities Can Save Water and Money. The POLIS Project on Ecological Governance, University of Victoria. October 2006. Online at http://www.polisproject.org/polis2/PDFs/toptenweb.pdf.

[9] Water Supply Plan Comments, a letter to local officials by David Hirschman and Stephen Bowler. May 4, 2008. Their informal analysis has water conservation outranking or equaling the current RWSA water supply plan and the dredging option in all planning objectives except increasing supply and withstanding possible contamination.