



down to earth

Environmental Restoration Quarterly • Fall 2023

1 Under the [Empty] Radar:
The Making of a Drought

2 Under the Radar, cont'd.

3 Piney Run Reservoir
Monitoring

4 Environmental Symposium

4 Meet the Staff



Under the [Empty] Radar: The Making of a Drought

By Zachary Neal, Hydrogeologist

“When the Well is Dry, We Know the Worth of Water” - Benjamin Franklin

When did you first notice it? The desiccated soil; the diminished streamflow; the stressed vegetation. Depending on where you are in the County, maybe you never really did. While not a stranger to these phenomena, Carroll County has been experiencing drought this year, and for quite some time. Unlike intense storms and other natural hazards that present themselves immediately, droughts tend to occur and build slowly, and may manifest in different ways. Some may significantly affect vegetation and crops, while others have greater hydrologic impacts. Oftentimes, people don't notice droughts are occurring until they are well underway in both duration and severity.

Carroll County is not alone in feeling the effects this year, but the distribution and morphology of this drought has been interesting to track, even just across the County. It may surprise you that the framework for its origin can be traced back to at least March, arguably even earlier.

A Delicate Balance

Hidden beneath your feet lies a system in flux, nature's balancing game of ins and outs. It's one that is often out of sight and out of mind, with many components that you never get to directly see. The “in's” can simply be boiled down to precipitation in most cases, but other vectors of inflow exist. The “out's” can simply be reduced to evapotranspiration (losses from evaporation and transpiration from plants) and streamflow, though many other vectors and transfers technically exist, including groundwater withdrawals. The change in storage is what's left on the other side of the equation, and it represents the balance of those “in's” and “outs.” In a hydrology textbook, it might look something like this for a simplified conceptual watershed: $\Delta S = P + G_{in} - (Q + ET + G_{out})$ Fancy equation, right? But what does it mean? Ultimately, a change in storage is a function of precipitation, evapotranspiration and streamflow, though stream baseflow patterns serve a good indicator of the ongoing battle between precipitation and evapotranspiration (Fig 1).

(Continued on page 2)

ATTENTION:

MDE has upgraded Carroll County to

DROUGHT WARNING

MDE and Carroll County ask residents to be mindful of water usage and voluntarily reduce water use by 10% to 15%.

Under the [Empty] Radar: The Making of a Drought

(continued from page 1)

In Carroll County, precipitation tends to be about evenly distributed throughout the year. Evapotranspiration rates fluctuate; they increase as vegetation activates/grows and temperatures increase, and they decrease as vegetation goes dormant and temperatures decrease. When evapotranspiration exceeds precipitation, we see the hallmarks of our reduction in storage: declining groundwater levels and declining stream baseflow's (Fig 2). When precipitation exceeds evapotranspiration, the opposite is true.

Not All Precipitation Events Are Equal

Another critical consideration to the balancing act is the type of precipitation received. Steady, slow rainfalls that occur over a day, or snow events that slowly melt and seep into the ground, significantly boost groundwater recharge and lead to higher groundwater levels and higher stream baseflows. Two inches of slow, steady rainfall are far more beneficial than two-inch quick thunderstorms, which mostly result in rapid, temporary runoff to streams as stormflow. Those steady rains/snows in the winter contribute significantly towards storage replenishment, and when steadier rains are received during the summer, they help lessen the blow that evapotranspiration deals.

2023 in Review: A Hydrologic Focus

The water year (starts October 1st) is not the same as the calendar year, but it's during the start of that period that the

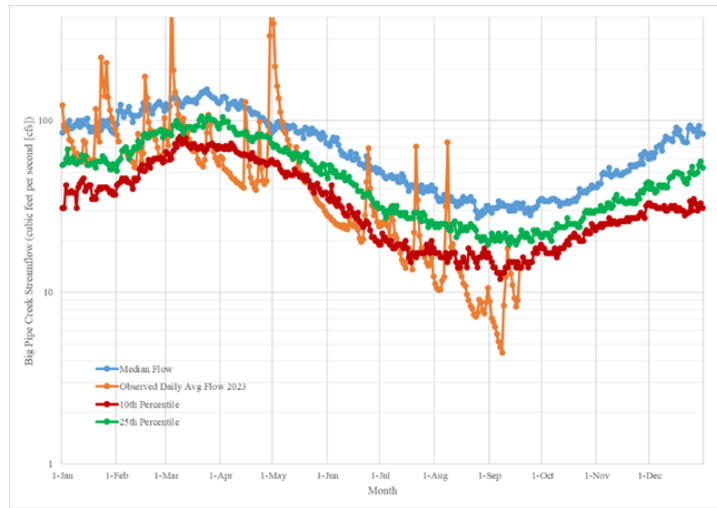


Figure 1

first small cut was dealt. By early November 2022, pockets of abnormally dry conditions were manifesting in the County, particularly near Hampstead, Taneytown, and Union Bridge. Water levels were around the low-end of what would be considered their “normal” ranges in those areas. Months went by and rains came and went, but the next big blow arrived by March, when the County received about half of its normal rainfall for the month. April showers, which arrived more as infrequent downpours, did not give way just to May flowers, but a significant rainfall deficit, dealing a significantly deeper cut that started to draw the attention of hydrologists. Between April and May, groundwater levels and stream baseflows were both below normal. With evapotranspiration then in full swing, it was a deficit the County wouldn't overcome through the

summer, where infrequent, spotty thunderstorms didn't provide much aid.

What's Low Got to Do, Got to Do with It?

Much like streams, groundwater wells don't necessarily have a fixed yield. During wetter times and periods of elevated groundwater levels, yields are typically higher. As the effects of drier conditions and drought continue and groundwater levels decline, yields typically decrease. Few wells have shown to be immune from such effects, but the people most impacted are those in possession of wells that didn't yield much to begin with; about 1 gallon per minute.

A “Watershed” Moment

Going into fall (and winter), we find ourselves at a pivotal moment. As evapotranspiration rates decline towards their seasonal lows, this becomes the opportunity for groundwater to replenish. El Nino is anticipated to be strong this winter, and much of our hydrologic fate depends on how the jet stream will (or will not) track moisture our way. While a one-year drought is certainly manageable, it's when those winter recharge events don't arrive that we truly find ourselves in trouble the following year. As our climate continues to change, there's great uncertainty as to the hydrologic impacts. What's generally hypothesized and agreed upon, however, is that our extremes (both flooding and drought) will likely become more commonplace.

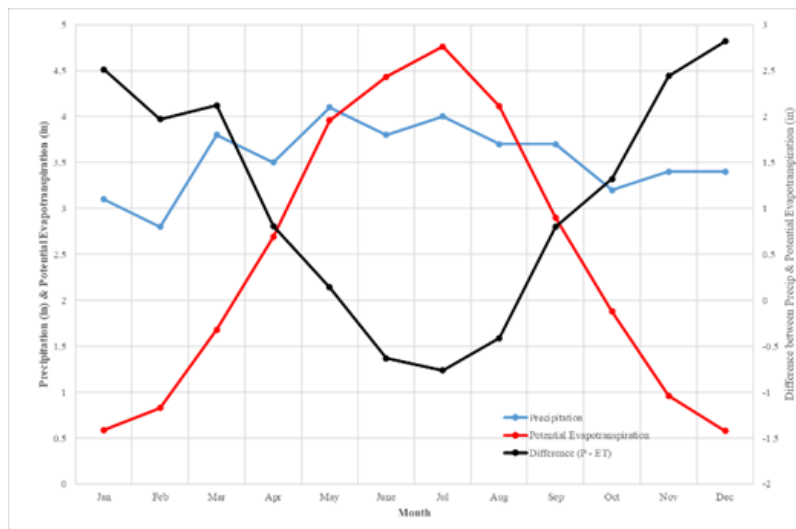


Figure 2

Piney Run Reservoir Monitoring

By Rob Flora-Nakoski

Piney Run Reservoir, completed in 1974, impounds up to 2 billion gallons of water; the original intent being supplemental water supply in the Freedom Area. Since it has always been more economical to upgrade the Freedom Water Treatment Plant, drinking water has never been withdrawn from the reservoir and the appropriation permit was allowed to expire in 2014. Currently, the primary uses of the reservoir are recreation and flood control.

In the early 1990's, a water monitoring program was created to support the proposed and current uses of the reservoir in order to identify any potential water quality concerns, characterize the lakes response to various weather events, aid management of the reservoir as a fishery resource, and to establish baseline data for long term trends. While the 6,500 acre watershed was and is dominated by agricultural land uses, increasing development meant that impervious area has grown significantly, which can potentially alter the chemical and hydrological inflow to the reservoir. The primary component of the monitoring program has always been routine reservoir sampling, however, the secondary components include inflow sampling, various types of special sampling, such as plankton analyses, and macrophyte synoptic surveys. In the late 1990's, the reservoir was added to the 303(d) list, signifying the reservoir as a water body "impaired" by nutrients and sediments. The County was allowed to defer the potential TMDL by developing watershed protection and implementation plans and most importantly, ensuring that nutrient loadings do not increase and that there is no further degradation of water quality.



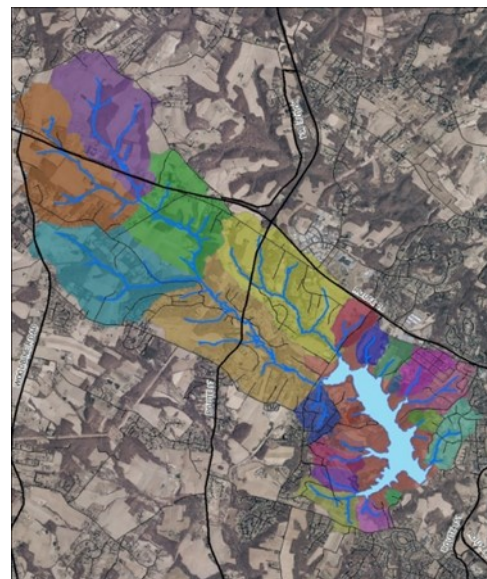
Blue-Green Algae bloom at dock

Piney Run Reservoir is designated as use class III-P, which signifies its intended use as a public water supply, fishery, and recreational water body. An impaired status means that water quality standards necessary for a water body's use class are not being attained. Impairment for nutrients generally refers to water bodies that are considered "eutrophic", of which Piney Run has been previously considered to be at the threshold of eutrophy. In eutrophic systems, elevated nutrient loadings allow for an increase in biological growth. If this occurs too rapidly or too often, dissolved oxygen can be depleted, pH can be thrown off balance, and water can become increasingly turbid, leading to an unhealthy environment for aquatic life and potential drinking water that is much more difficult and expensive to treat.



New boat motor in action

The BRM has been continuously monitoring on a bi-weekly basis to assess the trophic status and water quality of the reservoir. A new motor was acquired for the reservoir monitoring boat in 2023 to assess the trophic status much faster and more reliably. Various physical and chemical parameters are used to assess water quality, most importantly being concentrations of the various forms of nutrients (nitrogen and phosphorous). Turbidity, chlorophyll, temperature, pH, dissolved oxygen, E. coli, plankton, and iron are a few of the other common parameters measured. After the watershed restoration plan was implemented in the 2000's, ambient nitrogen and phosphorous concentrations within the reservoir have



Piney Run Reservoir Watershed

remained relatively low. While few nutrients are input to the reservoir, BRM staff also previously concluded that internal nutrient recycling is also negligible. However, several conditions consistent with eutrophic systems still occur periodically, but not persistently. The anoxic zone in the reservoir still extends up to around 11-foot depth during summer stratification, while turbidity and chlorophyll (phytoplankton) are both elevated during certain periods of the growing season. Much of this, particularly during late summer and early autumn can be attributed to blue-green algae, which can fix nitrogen from the air and store phosphorous and often form algal blooms within the reservoir. While many of the genera commonly identified within the reservoir have the potential to create an HAB (harmful algal bloom), BRM staff evaluates and tests potential HABs for cyanotoxins such as microcystin, which have not been observed for many years. Piney Run Reservoir is still on the threshold between mesotrophy and eutrophy and has remained largely stable for many years. The reservoir is still well suited to recreation and fishing and remains a good potential drinking water source.

Carroll County's 2nd Annual Environmental Symposium & Recycled Art Contest

October 28th

9:00 AM—12:00 PM

Carroll County Agriculture Center
Alesia/Medford Buildings
706 Agricultural Center Drive
Westminster

www.carrollcountymd.gov/environmentalsymposium

Contact: Kelly Martin at krmartin@carrollcountymd.gov



FRIENDS OF HASHAWHA
BEAR BRANCH

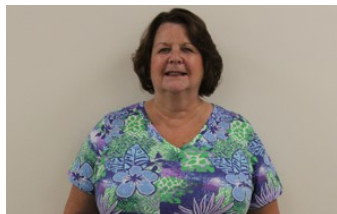


Bureau of Solid Waste



Meet the Staff

Gail Hawkins
Office Associate



Gail grew up in Carroll County before moving to Pennsylvania. She has worked with Carroll County Government for 23 years. Most of her time was with the State's Attorney's Office. Before coming to Resource Management in August, she worked in Human Resources. Gail has one son, Colin, who's currently serving in the United States Air Force. She is very proud of the work he has accomplished! In her spare time, she enjoys spending time with her family and gardening.



GUNPOWDER
VALLEY
CONSERVANCY

Venture Crew 202

Trout Unlimited