

## **LVL Water Quality Update for Spring 2020**

This water quality report provides an update on water quality issues that Leesville Lake faces as we enter the 2020 season. The team that works on these issues includes members of our Association's Water Quality Committee (Tony Capuco, Dave Waterman and Kathleen Giangi), our collaborator at the University of Lynchburg, Dr. Thomas Shahady, and his team in the Department of Environmental Science, University of Lynchburg.

Before discussing the current state of Leesville Lake, let me apprise you of developments from last year's water monitoring efforts. We completed two years of monitoring water in the Pigg River watershed - from Leesville Lake to the Rocky Mount area. This was initiated because it has become increasingly clear that the Pigg River presents a potential threat to the health of our lake. Our efforts last season confirmed the impaired nature of the Pigg River and we expanded our water assessment to include molecular approaches that enabled us to determine which animal species contribute to the high bacterial count in the river, which was particularly prominent after rains. During the course of our monitoring efforts we discovered the accumulation of a huge amount of debris at the Power Dam Road crossing. This was reported to our debris committee and the huge debris field was consequently removed by VDOT contractors and by Friends of Rivers of Virginia (FORVA). This debris would have found its way to our lake. FORVA seemingly was aware of the debris field and facilitated its removal.

Surprisingly, in the fall (Sept-Oct 2019) we discovered human waste contamination at Rocky Mount. The waste water treatment plant on the river was not the cause. The problem area was primarily along Furnace Creek. Although the human waste contamination diminished by the time the river reached Leesville Lake, we have pursued the issue to support the health of our neighboring community of Rocky Mount. As the Pigg River approached Leesville Lake, bacteria in the waters were primarily derived from cattle and deer. It is this agricultural and wildlife contamination that primarily impacts our lake.

The human waste contamination was reported and discussed with health administrators and environmental agencies and with appropriate authorities in Rocky Mount. On multiple occasions in February and March, water samples were obtained by waste treatment group in Rocky Mount, in conjunction with Virginia Department of Environmental Quality. They found sporadically high bacterial counts in several areas on Furnace Creek, but did not find an obvious source. These investigations will continue in an effort to identify the problem source(s).

To improve health of the Pigg River and reduce its negative impact on Leesville Lake, we are attempting to identify regions of concern for contamination from agricultural and wildlife waste, as well as methods whereby that runoff can be limited. This will be a difficult and time consuming effort, necessitating the assistance of multiple partners. Dr. Shahady will likely prepare a TMDL (total maximum daily load plan) for the Pigg River to provide a base for this effort.

Beginning in April, we initiated this season's water monitoring on Leesville Lake. However, water monitoring of the Pigg River will depend on obtaining sufficient funding and identifying appropriate cautionary measures to permit personnel to travel and sample in close proximity during the current pandemic.

Health of our lake changed in May. Dr. Shahady's sampling of Leesville Lake in April found no reason for concern, as water quality measures were consistent with findings previously obtained at this time of

year. However, the state of the lake subsequently degraded due to the impact of heavy rainfall. Dr. Shahady prepared a report dealing with his recent water quality evaluation on May 29<sup>th</sup>. In his accompanying report, Dr. Shahady has documented issues with photos and data, and stresses that Leesville Lake is impacted by two disparate water sources, the Pigg River and Smith Mountain Lake. The Pigg River has been a source of debris over the years and particularly problematic these past weeks. Importantly, water in the Pigg River is of poor quality. After rains it is highly laden with sediment and bacteria. Water from Smith Mountain Lake is of high quality, debris free, and serves to dilute the impact of Pigg River water. Furthermore, pump-back operations of the dam divert a portion of the Pigg River water to Smith Mountain Lake. Because of the recent heavy rain events, we believe that water release and pump-back operations of Smith Mountain Lake Dam were minimal. Because of the very high sediment and bacterial content of the Pigg River during these flash flood conditions, sediment and bacterial levels in Leesville Lake were high throughout the entire lake, even at the Leesville dam. Similar conditions have been noted at other small lakes in Virginia (e.g. Claytor Lake).

Finally, many have noted a large number of dead fish (primarily carp) in the lake. There are several factors that may have contributed to this. According to the Department of Environmental Quality and the Department of Games in Inland Fisheries (DGIF), this event is not uncommon in waters of Virginia during the spring and appears to be caused by a carp disease supplemented with spawning stress. Notably, an outbreak occurred on the Blackwater tributary in 2017. As Dr. Shahady points out, additional stress may be imposed by the presence of large amounts of sediment in the water, which impairs gill function. Finally, the very high water level in Smith Mountain Lake, which caused water overflow into the spillway may have caused injury to fish that were carried into the spillway.

We appear to be experiencing a change in weather patterns, with frequent heavy rainfalls in our area over recent years. It is likely that this will persist and present challenges in the future. Consequently, it is important that we maintain our efforts to monitor water quality and to ameliorate the impact of heavy rain on the Pigg River.

On behalf of the water quality team,

Tony Capuco

Interim Report  
Leesville Lake Water Quality Monitoring  
Submitted to Leesville Lake Association  
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## Summary:

Water quality sampling of Leesville Lake on May 29, 2020 raised several areas of concern. First and foremost is the continued influx of sediment, bacteria, debris and nutrients from Pigg River. This problem, identified and studied more intently over the past several years, now highlights concerns over proper management of Leesville Lake. The Pigg River watershed must be better managed to properly protect the water quality of Leesville Lake. Second, hydrology resulting from pump operations clearly influences the quality of water in the lake. Smith Mountain Lake tail water is essential to the improvement of water quality in Leesville Lake and management of lake levels is important for regulating Leesville Lake water quality. Leesville Lake is clearly the result of two separate water systems and must be managed with this in mind.

## Introduction:

Leesville Lake has been studied through a partnership between AEP, Leesville Lake Association and University of Lynchburg beginning in 2010. Reports on the water quality of Leesville Lake can be found on the Leesville Lake website <https://leesvillelake.org/>, Center for Water Quality website <https://www.lynchburg.edu/academics/academic-community-centers/center-for-water-quality/reservoir-water-quality/leesville-lake/> and AEP. It is not the intent of this interim report to synthesize or summarize water quality from past observations and I direct the reader to the past reports for this information. It is the intent of this report to document scientific findings from the May 29, 2020 sampling and to speculate on the implications these findings may have on the current and future water quality of the lake.

## Methods:

Leesville Lake was monitored on May 29, 2020 as part of the annual monitoring program. During the monitoring a number of parameters were evaluated throughout Leesville Lake (details of the sampling procedures can be found in the annual reports. These included temperature, dissolved oxygen, pH, oxygen reduction potential, turbidity, chlorophyll a and conductivity. Additionally, *E. coli* and zooplankton were been analyzed. While both total phosphorus and nitrate samples were taken, these data were not analyzed for this report.

## Results:

Initial observations of Leesville Lake on May 29, 2020 were the very low water level (near 602 feet) and the amount of debris that had accumulated around the boat launch at the dam (Figure 1). The condition of the lake apparently caused AEP to park a truck on the ramp and declare the ramp “closed.” Additionally, water at the dam was very turbid for this region of the lake, appearing brown in Figure 1.



Figure 1 – Virginia Department of Games and Inland Fisheries boat ramp at Leesville Lake Dam. In this instance, it a parked AEP truck prohibited access to the lake.

The extent and amount of debris that had accumulated at the dam was remarkable (Figure 2). A crew from AEP was actively working to move the debris to the shore with a pontoon boat and then removing it from the lake with a trackhoe. With the exception of events immediately after destruction of the Pigg River Power Dam, debris of this magnitude has not been observed. Contrast this photo with Figure 3. This is similar to the buildup of debris at the bridge on Power Dam Road in Rocky Mount Va. It seems clear debris is entering the Pigg River from sources in the watershed and then traveling down river and into Leesville Lake.





Figure 2 – Buildup of debris at Leesville Lake dam due to heavy rains throughout the area.





Figure 3 – Debris buildup at the bridge on Power Dam Road in Rocky Mount Va. Photo taken September 18, 2019.

Traveling up lake the water quality continued to degrade. Near MM9, I began to observe a fish kill (Figure 4). We estimated over 30+ fish (mostly carp) throughout the lake from MM9 and up into areas near and into SML tail waters.



Figure 4 – floating dead fish near Mile Marker 9 in Leesville Lake.

Near Toler Bridge several observations were made. The water was extremely turbid (Figure 5). While turbidity is often observed at this location after rain events, this turbidity was very strong in color Smith Mountain Lake was discharging during the sampling event and a clear turbidity demarcation between Pigg River water Smith Mountain Lake water was apparent near the mouth of the Pigg River (Figure 6). But water from Pigg River very rapidly fanned out across the lake at Toler Bridge causing brown turbid water downstream throughout the entire lake.





Figure 5 – Water quality observations at Toler Bridge on May 29, 2020.

The contrast between water flowing from the mouth of Pigg River into Leesville Lake and tail waters of Smith Mountain Lake was very strong (Figure 6). While this pattern has been observed previously, the thick contrast between Pigg River and SML tail water was severe.



Figure 6 – water contrast between water flowing from Pigg River and tail water release from SML.

Finally, water quality observed at the tail water section of the reservoir was in stark contrast to the remainder of the reservoir (Figure 7). For example, Secchi depth (a measure of water visibility) of water in Pigg River was 0.2 meters while a similar measure at tail waters was 2.8 meters. The contrast could not be more severe. During this sampling day, water quality suggests that the lake water reflected that of two different reservoirs. We did additionally note dead fish in the tail water section.





Figure 7 – tail water portion of Leesville Lake May 29, 2020.

#### Data

The lake was not stratified so measures were similar from top to bottom. This is in contrast to previous years where the lake is well stratified by this point in time. To summarize (Table 1), water quality entering from SML tail water is of good quality and combines with water from Pigg River that is severely impaired. This slowly dilutes and distributes the poor quality Pigg River water throughout the lake. These data support the photo observations.



Table – 1. Surface water quality data in Leesville Lake May 29, 2020.

	Temp (C)	Oxygen (%)	Turbidity (NTU)	Chlorophyll a (ug/L)	Secchi (m)	<i>E. coli</i> (cfu/100ml)
LL Dam	20.3	118	32	35.8	0.6	150
MM6	18.5	88	39	7.1	0.4	1300
Toler	14.3	72	84	5.0	0.25	1450
Pigg	19.8	91	441	8.9	0.2	6867
Tailwater	14.5	83	3	5.2	2.8	10

Oxygen % = percent saturation, NTU = nephometric turbidity units, measure of suspended solid particles, chlorophyll a = a particular form of chlorophyll needed for plant photosynthesis the level is used to indicate plant productivity, Secchi = depth (in meters) to which markings on a submerged disk are visible, cfu = colony forming units, measure of the number of live bacteria.

#### Discussion:

Two issues of concern have been addressed by this interim report. The first is general water quality related to the Pigg River watershed and the management of flow to and from Smith Mountain Lake. It is clear from this sampling data the water quality of the Pigg River was so severe that under conditions prevalent at the time of sampling that it impacted the entirety of Leesville Lake. Sediment along with bacteria plagued the waters entering the lake from Pigg River. These concentrations were so high that the entire reservoir was impacted (38 – 32 NTU) from MM6 to the dam. The inflow of sediment (441 NTU) and bacteria (6867 cfu *E. coli*/100ml from Pigg River suggest worsening conditions in the Pigg River. In order to manage Leesville Lake the Pigg River Watershed must be controlled.

In addition to the measures in Table 1, there was a massive input of debris (Figures 1-3). The problem was so severe that it impacted recreational access to the lake and clearly presented a safety hazard to personnel and property. Strategies need to be implemented by AEP and partners to deal with issues of water quality and debris.

Secondarily, the fish kill observed is concerning to those on the lake. The vast majority of fish were carp and several factors that may have contributed to their death. According to the Department of Environmental Quality and the Department of Games in Inland Fisheries (DGIF), this event is not uncommon in waters of Virginia during the spring and appears to be caused by a carp disease supplemented with spawning stress. Notably, an outbreak occurred on the Blackwater tributary in 2017. Additional stress may have been imposed by the presence of large amounts of sediment in the water, which can impair gill function. Suspended sediment is known to have deleterious impacts on fish

and in particular carp (Xu et al. 2018). The majority of the fish observed were in the upper reaches of the reservoir where sediment concentration are highest.

Finally, the very high water level in Smith Mountain Lake, which caused water overflow into the spillway may have caused injury to fish that were carried over the dam. Algera et al. (2020) document injury and fish mortality may occur during fish passage through hydroelectric dams; however, such fish kills have not been noted during other periods of power generation and turbine function. What was novel was that the high water level of Smith Mountain Lake resulted in passage of water (and fish) via the spillway. This may have caused significant fish mortality.

All of the data and interpretations in this report will be analyzed in greater depth in the 2020 annual report. It is the intent of this report to give the Leesville Lake Association relevant data and interpretation to help manage the reservoir this season.

## References

Algera DA, Rytwinski T, Taylor JJ, Bennett JR, Smokorowski KE, Harrison PM, Clarke KD, Enders EC, Power M, Bevelhimer MS, Cooke SJ (2020) What are the relative risks of mortality and 1 injury for fish during downstream passage at hydroelectric dams in temperate regions? A systematic review. *Environ Evid* 9:3

Xu, F., B. Baoligao, X. Chen, X. Li, H. Deng and X. Shang. 2018. Quantitative assessment of acute impacts of suspended sediment on carp in the Yellow River. *River Res. Applic.* 34:1298-1303.