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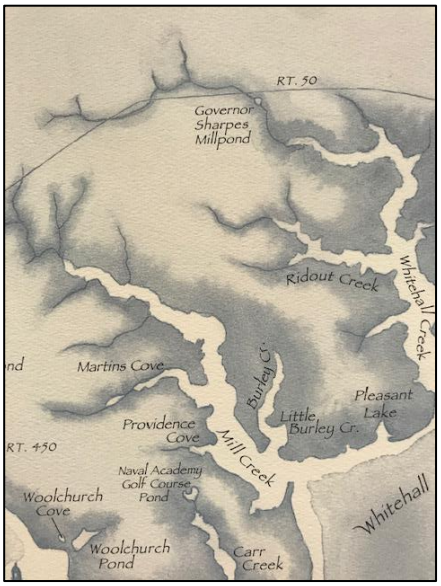
SRA Creek-by-Creek Report
Mill and Burley Creek

2020 Water Column Dissolved Oxygen, Bottom Dissolved Oxygen, Average Salinity, and Clarity Analysis

By Emi McGeady, Field Investigator

aerial photo: marinas.com



Abstract

Conditions in Mill and Burley Creek were moderate in 2020, with better conditions occurring towards the mouth of the creeks. Dissolved oxygen was typically in the good to moderate range, with few incidents of dead zone occurring in summer. For all of monitoring salinity was in the tolerable range for Severn River life (5-18 ppt), and steadily increased from summer to fall. Clarity was generally poor in Mill Creek and Burley Creek. Moderate and good clarity was only observed in November.

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INTRODUCTION

Thanks to generous support from the Delaplaine Foundation, The Severn River Association (SRA) created its water quality program in 2018 to track the conditions of the Severn River, a natural resource so many Maryland residents and communities enjoy for fishing, crabbing, swimming, and boating. Since 2019 the program has run weekly from late May to early November and tracks temperature, dissolved oxygen, pH, salinity, and clarity throughout the entire water column at 44 stations across the watershed.

This analysis focuses on three important parameters of water quality: dissolved oxygen (d.o.), salinity, and clarity, in Mill Creek and Burley Creek. Mill and Burley Creek are located just north of the mainstem Severn River, off of Whitehall Bay. Along the creeks are the Providence and Hidden Point communities, as well as the USNA golf course. The areas studied include SRA's water quality monitoring stations titled Mill Creek #1 (MC1), Mill Creek #2 (MC2), Mill Creek #3 (MC3), and Burley Creek (BC) located on figure 1 below.

Monitoring in Mill Creek and Burley Creek in the 2020 monitoring season occurred biweekly from June 12th to November 6th. This resulted in a total of 10 monitoring days and 98 volunteer hours.

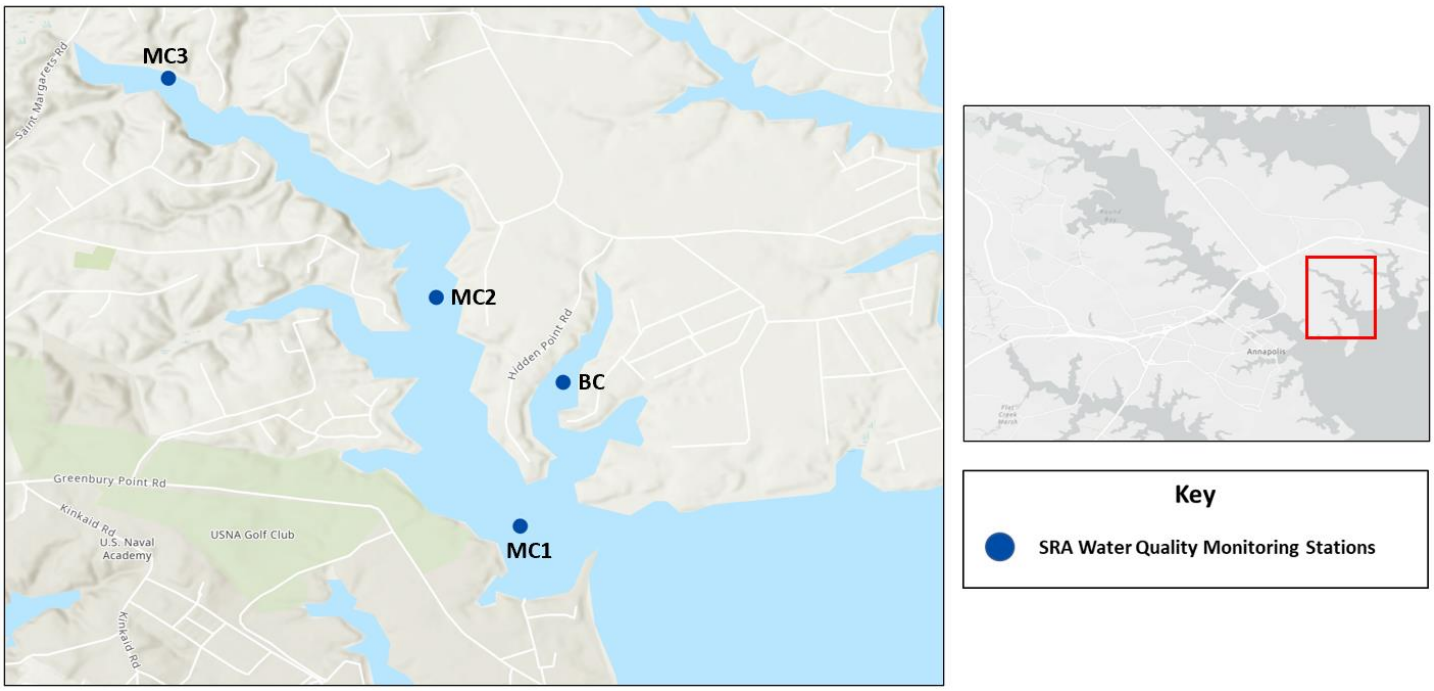

Figure 1. Locations of monitoring stations in Mill Creek and Burley Creek on the lower Severn River.

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EXECUTIVE SUMMARY

Water quality conditions in Mill and Burely Creek were moderate for the majority of monitoring in 2020. Dissolved oxygen (d.o.) levels fell into dead zone conditions (d.o. < 2.0 mg/L) in June, July, and August. Dead zone was typically only 0.5-1.0 meters tall however. Dissolved oxygen was typically lower at MC3, whereas towards the mouth of the creek at MC1, MC2, and BC, d.o. was typically moderate (2.0 mg/L < d.o. < 5.0 mg/L) or good (d.o. > 5.0 mg/L).

Average salinity fell within the mesohaline range of 5-18 ppt for the entire monitoring season, though in the summer it was fresher and became saltier over time. Average salinity grew from 6-7 ppt to 13-14 ppt at all stations. Average salinity did not vary much between MC1, MC2, and BC but it was consistently 0.5-1 ppt lower at MC3.

Clarity was typically bad at all stations, but it was consistently lowest at MC3. Clarity at all stations was generally below 0.6 meters through summer. Clarity then rose to moderate levels by late September for most stations. Good clarity was only measured once in 2020: 1.65 meters at MC2 on November 6th.

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ANALYSIS

Water Column Dissolved Oxygen

River life, including oysters, fish, and crabs prefer dissolved oxygen levels above 5.0 mg/L (depicted by green lines on the graphs below). Oxygen levels below 2.0 mg/L are insufficient for river life survival and are therefore designated as dead zone conditions (depicted by the red lines on the graphs below).

On each day of monitoring in Mill and Burley Creek, dissolved oxygen measurements were taken with a YSI probe. The probe was lowered to the bottom where the first measurement was recorded. The probe was then raised through the water column, taking measurements at every subsequent 0.5 meters. Depths at Mill Creek stations #1 and #2 were similar ranging from 3.0 to 3.5 meters deep. Burley Creek depths ranged from 2.0-3.0 meters deep. Mill Creek #3, located at the headwaters, was much shallower, only ranging 1.5-2.0 meters deep.

Dissolved oxygen measurements at each depth are displayed on figures 2-5 below. The lighter bars represent d.o. content in surface water (0.5 m deep), with the darker bars representing d.o. at subsequent deeper depths. Bars above the red line indicate depths where moderate or good oxygen levels were measured, and bars that fall below the red line indicate depths exhibiting dead zone conditions.

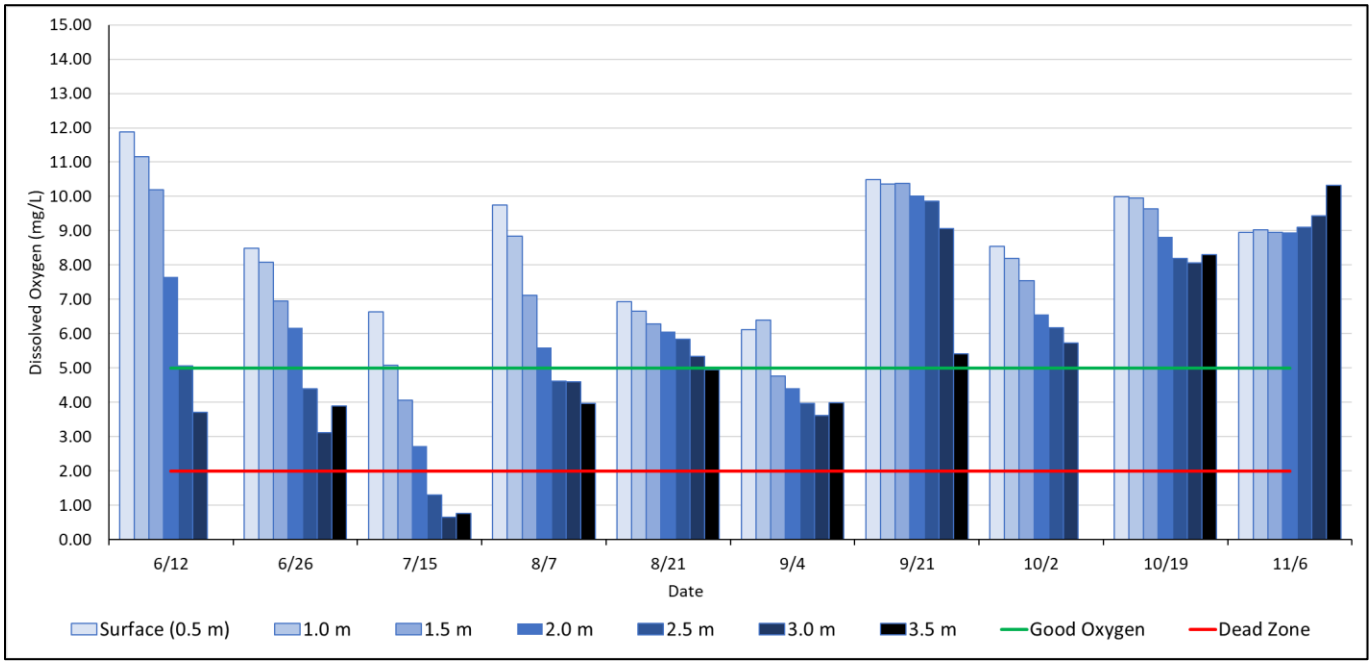

Figure 2. Dissolved oxygen levels through the water column at Mill Creek #1.

- Difference in dissolved oxygen across depth was more apparent in spring and summer, with surface water always holding good levels and deeper depths holding less oxygen, and occasionally exhibiting dead zone. Fall dissolved oxygen was always in the good level for all depths.
- Dead zone occurred on one day of monitoring, July 15th, from a depth of 2.5 meters to 3.5 meters. Dissolved oxygen levels at these depths measured 1.29 mg/L, 0.65 mg/L, and 0.76 mg/L.

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- Despite one incident of dead zone, all other monitoring days displayed moderate or good levels of dissolved oxygen at all depths.
- The highest d.o. reading recorded at Mill Creek #1 was 11.88 mg/L in the surface water on June 12th.
- The lowest d.o. reading recorded at Mill Creek #1 was 0.65 mg/L at 3.0 meters deep on July 15th.

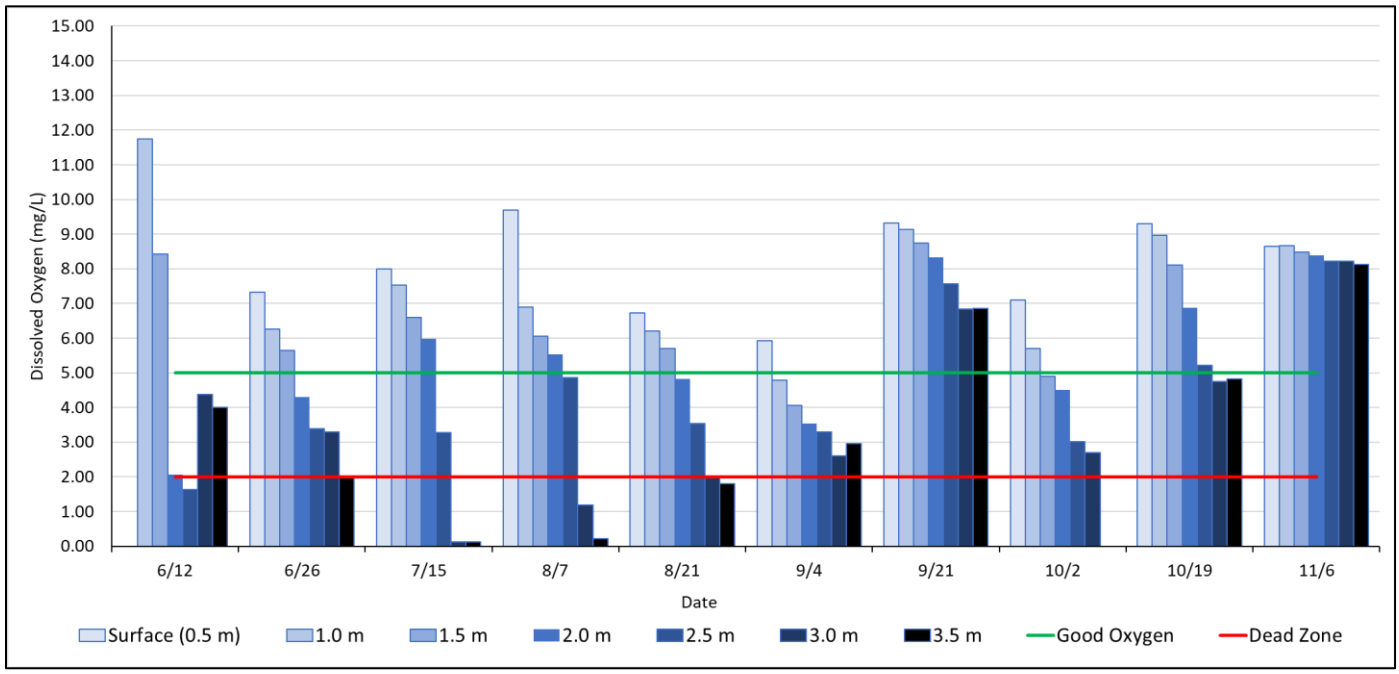

Figure 3. Dissolved oxygen levels through the water column at Mill Creek #2.

- Dissolved oxygen in surface water was similar at Mill Creek #2 and Mill Creek #1. However all other depths, d.o. was typically lower at Mill Creek #2.
- Mill Creek #2 had more incidents of dead zone than Mill Creek #1. Dead zone occurred on 4 days of monitoring in 2020: June 12th, July 15th, August 7th, and August 21st.
- The highest d.o. recorded was 11.75 mg/L in surface water on June 12th.
- The lowest d.o. recorded was 0.12 mg/L in the bottom water (3.5 m) on July 15th.

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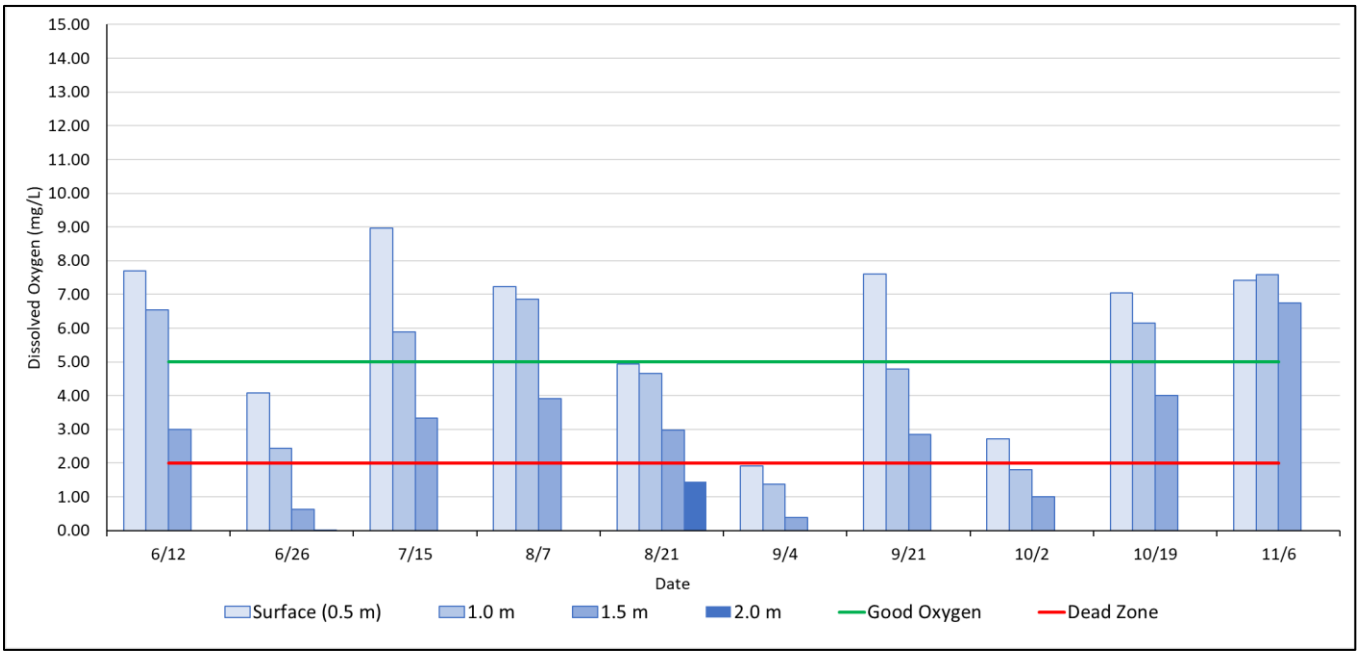

Figure 4. Dissolved oxygen through the water column at Mill Creek #3.

- Dissolved oxygen at Mill Creek #3 was more sporadic over the monitoring season, fluctuating from week to week.
- Dissolved oxygen was typically lowest here across depth, despite having the shallowest depth of the stations.
- The highest d.o. reading recorded was 8.96 mg/L in the surface water on July 15th.
- The lowest d.o. reading recorded at Mill Creek #3, and all other stations, was 0.03 mg/L in bottom water (3.0 m) on June 26th.

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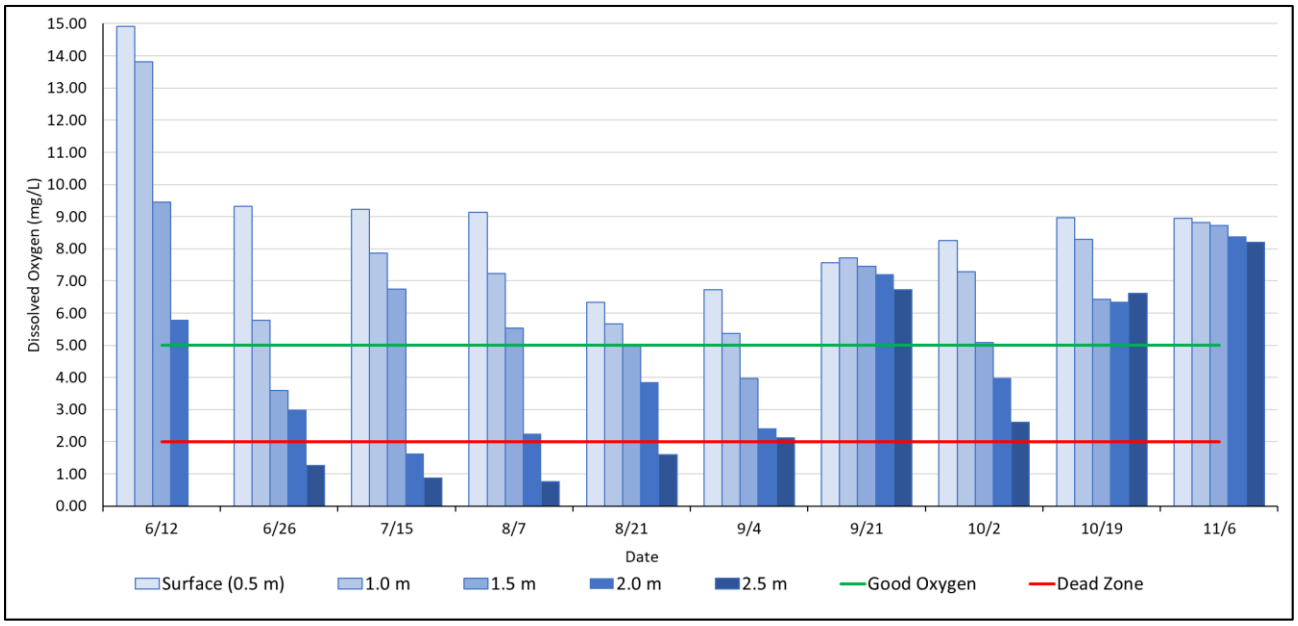

Figure 5. Dissolved oxygen through the water column at Burley Creek.

- Dissolved oxygen at Burley Creek station was comparable to Mill Creek #2. Most depths displayed moderate or good dissolved oxygen levels, with some dead zone occurring towards the bottom.
- Dissolved oxygen was highest frequently in the summer in the shallow water, with dead zone occurring in the deeper water. The highest dissolved oxygen measured of all the stations occurred here on June 12th in the surface water : 14.91 mg/L.
- Dead zone occurred at Burley Creek for 4 consecutive weeks in the summer, from June 26th to August 21st. The dead zone usually was only in the bottom water, except for July 15th when it occurred at 2.0 and 2.5 meters deep.
- The lowest d.o. recorded at Burley Creek in 2020 was 0.76 mg/L at 2.5 meters deep.

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Bottom Dissolved Oxygen

Measuring dissolved oxygen on the bottom is important for understanding conditions experienced by sedentary/less mobile creatures that cannot escape dead zone conditions, such as oysters, mollusks, and other benthic organisms. On each day of monitoring, bottom d.o. measurements were taken with a YSI probe. The probe was lowered until the bottom was felt by slack in the chord. Then the probe was raised to the nearest 0.5 m depth as to not be in the mud. Bottom d.o. measurements were recorded and displayed for each Mill and Burley creek station on figure 6.

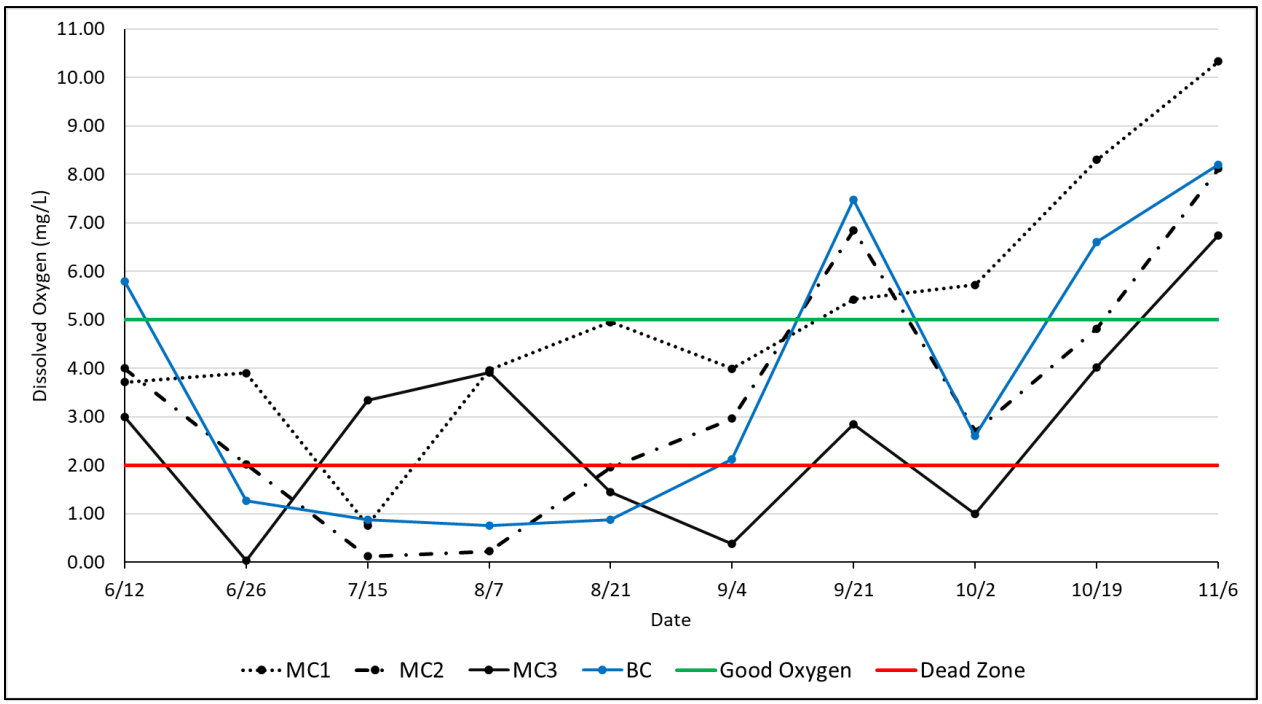

Figure 6. Bottom dissolved oxygen at Mill and Burley Creek stations.

- Bottom dissolved oxygen at Mill Creek #1 stays generally in the moderate or good range except for July 17th when dead zone was measured at 0.76 mg/L. Bottom dissolved oxygen then steadily increased and was highest on November 6th at 10.33 mg/L.
- Burley Creek and Mill Creek #2 follow a similar trend. Both stations start off with moderate or good oxygen on the bottom, 4.00 mg/L at Mill Creek #2 and 5.79 mg/L at Burley Creek. Then for 4 consecutive monitoring days, the bottom dissolved oxygen at both stations was in dead zone conditions ranging from 0.12 mg/L to 1.95 mg/L. Bottom dissolved oxygen then increased to a peak in September around 7.00 mg/L, fell to moderate levels the following week, and then rebounded to 8.12 mg/L at Mill #2 and 8.20 mg/L at Burley Creek.
- Except for being relatively better in July and August, bottom dissolved oxygen was consistently lowest at Mill Creek #3. Most readings were in dead zone conditions or moderate levels, ranging from 0.03 mg/L to 4.01 mg/L. Bottom dissolved oxygen only reach good levels on November 6th (6.74 mg/L).

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Average Salinity

The Severn River is a brackish water body. This means that it is neither fully freshwater (0 ppt) or fully ocean/saltwater (35 ppt)[1]. Instead the typical salinity range, or amount of dissolved salt in the water, of the Severn River is mesohaline (5-18 ppt)[2]. Severn River organisms and underwater grasses are adapted to this range of salt in their environment. Prolonged exposure to salinity outside of this range can cause negative effects such as stress, depressed growth, and decreased survival.

Salinity measurements were taken with a YSI probe at each depth on each monitoring day. The measurements were then averaged for each monitoring day because salinity from surface water to the bottom did not vary by more than 1 ppt. On figure 7 below, points that fall between the green and red line indicate average daily salinity in the expected mesohaline range.

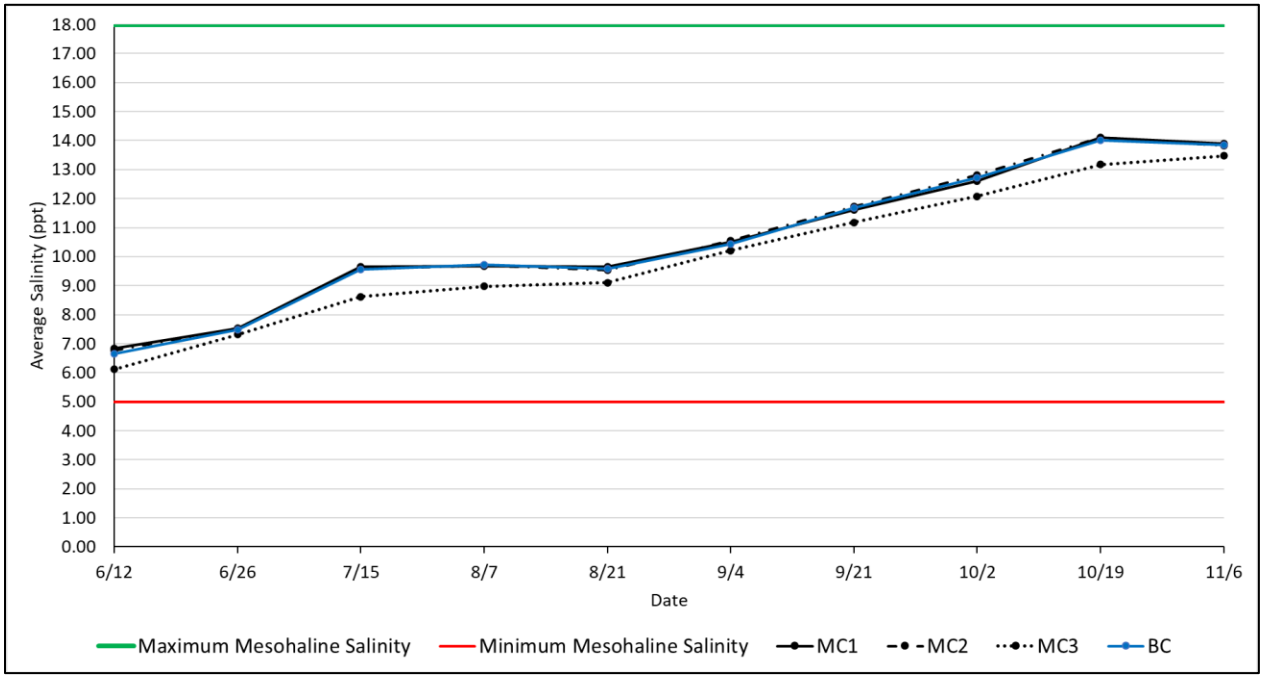

Figure 7. Average salinity at Mill and Burley Creek stations.

- For the entire 2020 monitoring station, average salinity at all stations was in the mesohaline range of 5-18 ppt.
- Average salinity steadily increased over the monitoring season for all stations, starting around 6-7 ppt in June and growing to around 13-14 ppt in November.
- MC1, MC2, and BC average salinity was extremely similar and followed the same trend over the monitoring season.
- Average salinity at MC3 was consistently lower than the other stations. Average salinity followed the same steady increase but was about 0.5-1 ppt lower each week.

[1] Chillrud, R. (2020, March 20). Is the Chesapeake Bay fresh or salty? Retrieved January 07, 2021, from https://www.chesapeakebay.net/news/blog/fresh_or_salty_bays_salinity_makes_a_big_difference_to_underwater_life

[2] Bergstrom, P., Murphy, R., Naylor, M., Davis, R., & Reel, J. (2006). *Underwater Grasses in Chesapeake Bay & Mid-Atlantic Coastal Waters*. College Park, MD: Maryland Sea Grant College.

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Water Clarity

Water clarity is a measure of how far we can see down into the water column. Higher clarity is indicative of less suspended sediment, algal blooms, and other pollutants that cloud the water. Tracking clarity allows us to understand water quality conditions better, and aid in determining sites suitbale for submerged aquatic vegetation (SAV) growth, that require sunlight to penetrate deeply into the water column.

To measure clarity, a Secchi disk was lowered into the water from the shady side of the boat until the pattern of the disk was no longer visible. The disk was then raised towards the surface of the water until barely visible. This depth was then recorded and displayed on figure 8 below. Good clarity in a mesohaline environment is any reading above 1.6 meters (green line). Bad clarity readings are considered as readings below 0.6 meters (red line).

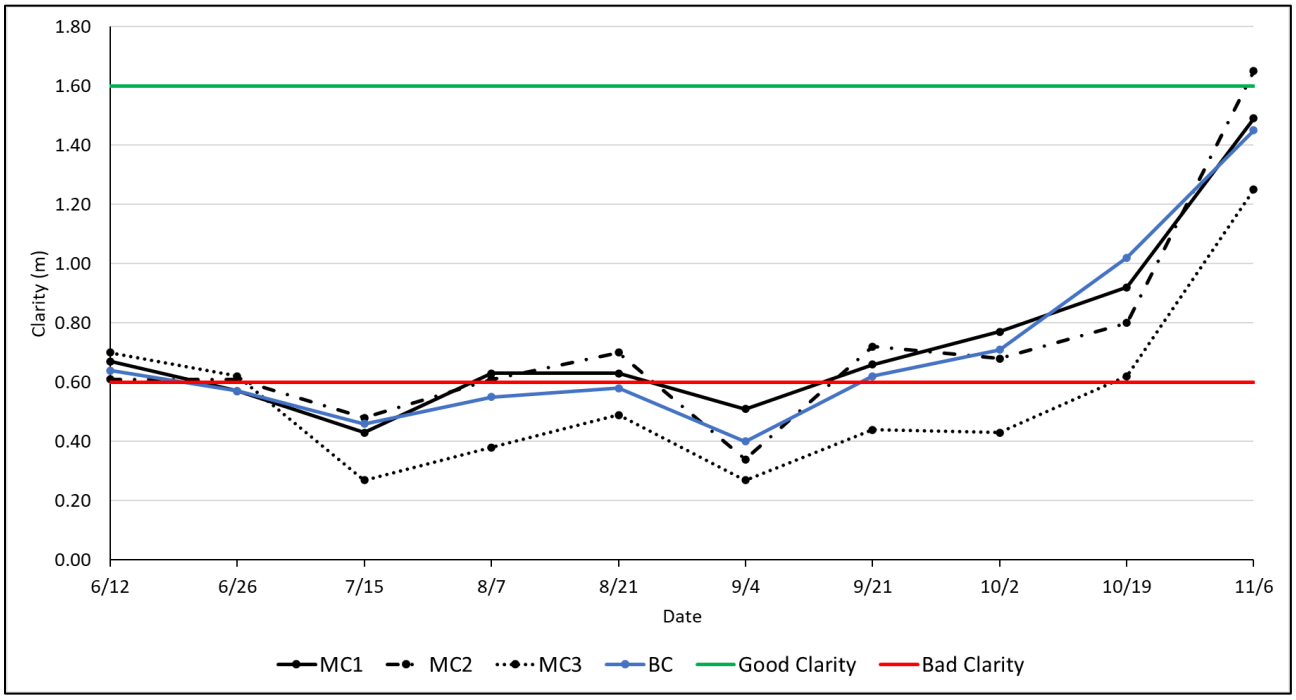

Figure 8. Water clarity at Mill and Burley Creek Stations

- Clarity at all Mill and Burley creek stations was generally poor. Bad clarity readings were recorded often in summer and into September, and even October at MC3. Clarity only reached the good level on the last week of monitoirng at MC2.
- MC3 clarity was the worst of all stations. It was consistently lowest here, with readings such as 0.27 m twice, 0.38 m, and 0.43 m in summer and fall. Moderate clarity was observed on the last day of monitoring: 1.25 m.
- Clarity at MC1, MC2, and BC typically averaged 0.5-0.7 m in summer, and then increased to moderate readings of about 0.8-1.5 m in fall.