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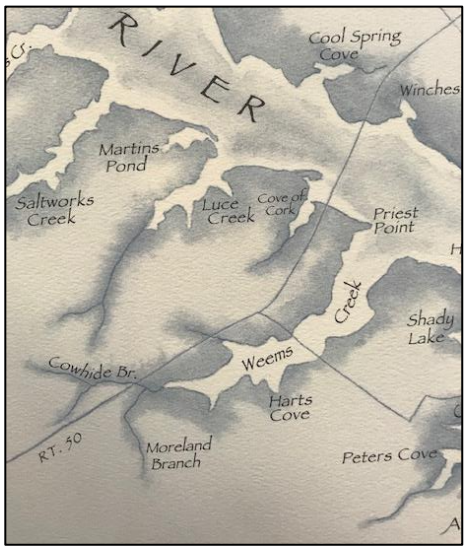
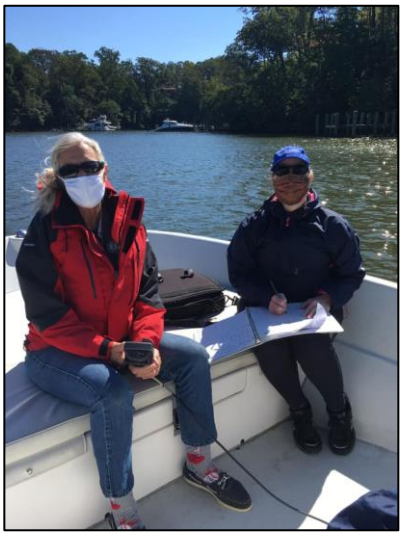
SRA Creek-by-Creek Report
Weems Creek

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

By Emi McGeady, Field Investigator





Abstract

Water quality in Weems Creek was a mix of good and bad in 2020. Dead zone was very persistent in the summer, with insufficient levels for fish and crabs in the bottom half of the water column. Dissolved oxygen increased to moderate and good ranges for river life in October. Average salinity steadily increased from May to November and was always in the expected mesohaline range of 5-18 ppt. Clarity was neither bad or good, but moderate, ranging 0.7-1.4 meters for most of the year.

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INTRODUCTION

Thanks to support from the Delaplaine Foundation, The Severn River Association (SRA) created a water quality program in 2018 to track conditions throughout the Severn River, a natural resource 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 dissolved oxygen (d.o.), salinity, and clarity, three important metrics of water quality, in Weems Creek. Weems Creek is located on the mid-Severn River in West Annapolis (figure 1). The creek is just upriver of Spa Creek in downtown Annapolis, and adjacent to the U.S. 50 Severn River Bridge. The areas studied in this report include SRA's water quality monitoring stations titled Weems Creek #1 (WC1) and Weems Creek #2 (WC2) (figure 1).

Monitoring in Weems Creek occurred weekly from May 28th to November 5th in 2020. This resulted in a total of 23 monitoring days and 205 volunteer hours.

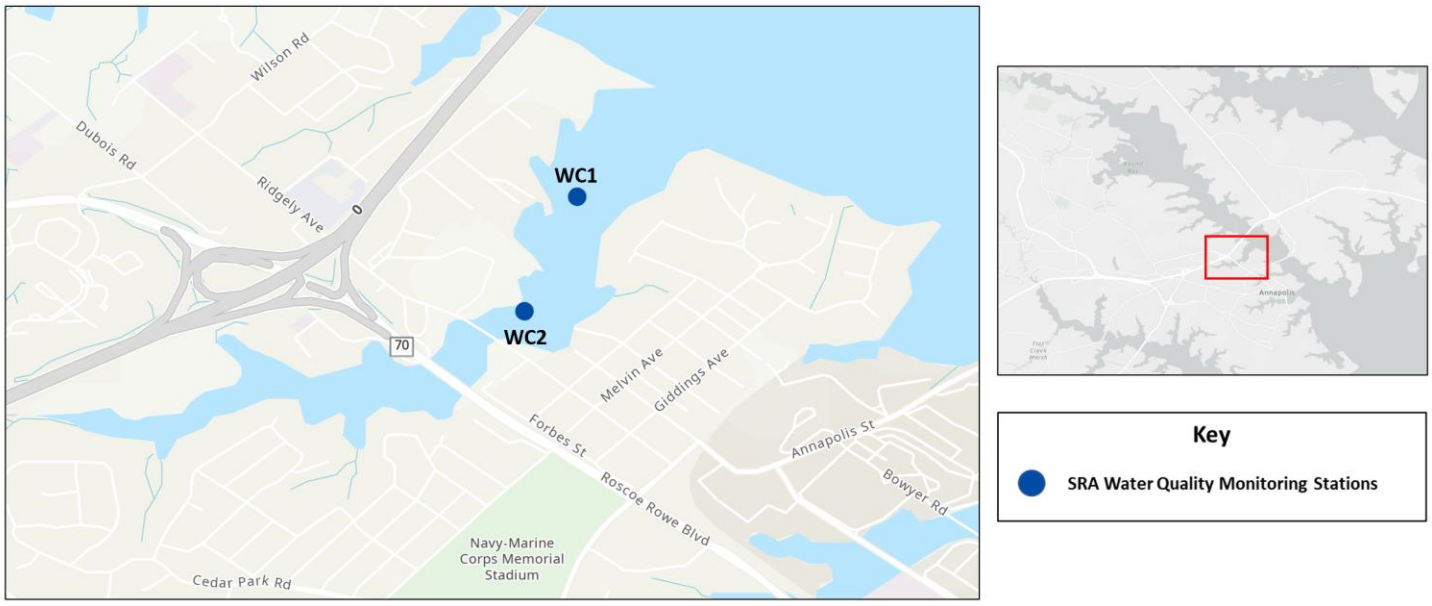

Figure 1. Weems Creek water quality monitoring stations in Annapolis, MD.

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EXECUTIVE SUMMARY

In 2020, dissolved oxygen in Weems Creek was generally poor, with many monitoring days when dead zone conditions (d.o. < 2.0 mg/L) were recorded. Dead zones were observed more often at WC2 than WC1 though dead zone occurred frequently during summer at both stations. At WC1, dead zone occurred on 9 days, usually only in the bottom half meter of water. At WC2, dead zone was recorded on 15 days, usually through half of the water column.

Dissolved oxygen conditions were better in the fall, though dead zone was recorded few times in September. Dissolved oxygen was usually in the moderate (d.o. >2.0 mg/L) or good range (d.o. >5.0 mg/L) for river life in fall.

At both stations 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, ranging from about 6.00 ppt to about 14.00 ppt. This salinity range is within the tolerance of many Severn River species. No clear difference between stations existed for average salinity.

Clarity was moderate in Weems Creek for the majority of 2020, usually ranging from 0.7 to 1.4 meters. Bad clarity was more likely to be recorded in summer, but this only occurred a handful of times, mostly in June. Good clarity was recorded in November at both stations (clarity over 1.6 m). No clear difference in station clarity existed.

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ANALYSIS

Water Column Dissolved Oxygen

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

On each day of monitoring in Weems 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 half meter. Depth at both stations was 4.0 meters.

Dissolved oxygen measurements at each depth are displayed on the graphs 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 to good oxygen levels were measured, and bars that fall below the red line indicate depths exhibiting dead zone conditions.

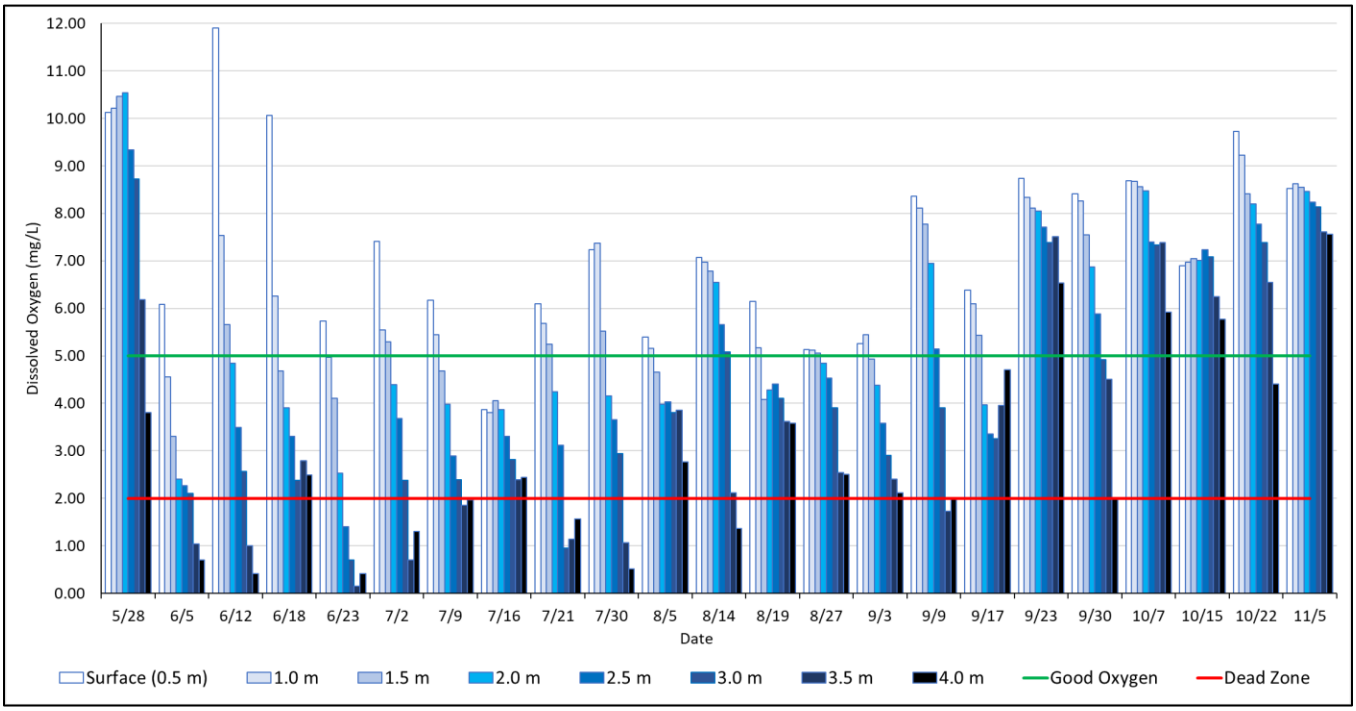

Figure 2. Dissolved oxygen through the water column at Weems Creek #1 in 2020.

- Dead zone conditions were recorded on 9 days of monitoring at WC1. Dead zone occurred most in June and July, but was recorded once in August and September as well.
- On days that dead zone was recorded, the dead zone was usually only 0.5 meters tall, extending from the bottom (4.0 m) to 3.5 meters deep. An exception to this is June 23rd when the dead zone was more extensive, measured from 4.0 meters up to 2.5 meters.

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- The lowest d.o. measured was 0.15 mg/L on June 23rd at 3.5 meters deep.
- Dissolved oxygen was better across all depths in the fall. Less dead zone was recorded in the fall, only one day (9/9), and d.o. was generally in moderate to good levels. Deeper depths had moderate oxygen (d.o. under 5.0 mg/L but above 2.0 mg/L) and shallower depths had good oxygen (d.o. above 5.0 mg/L).
- The highest reading, 11.90 mg/L, was recorded on June 12th in the surface water. Because this high d.o. was recorded in surface water but dead zone was recorded on the bottom, an algal bloom may have been present at the surface.

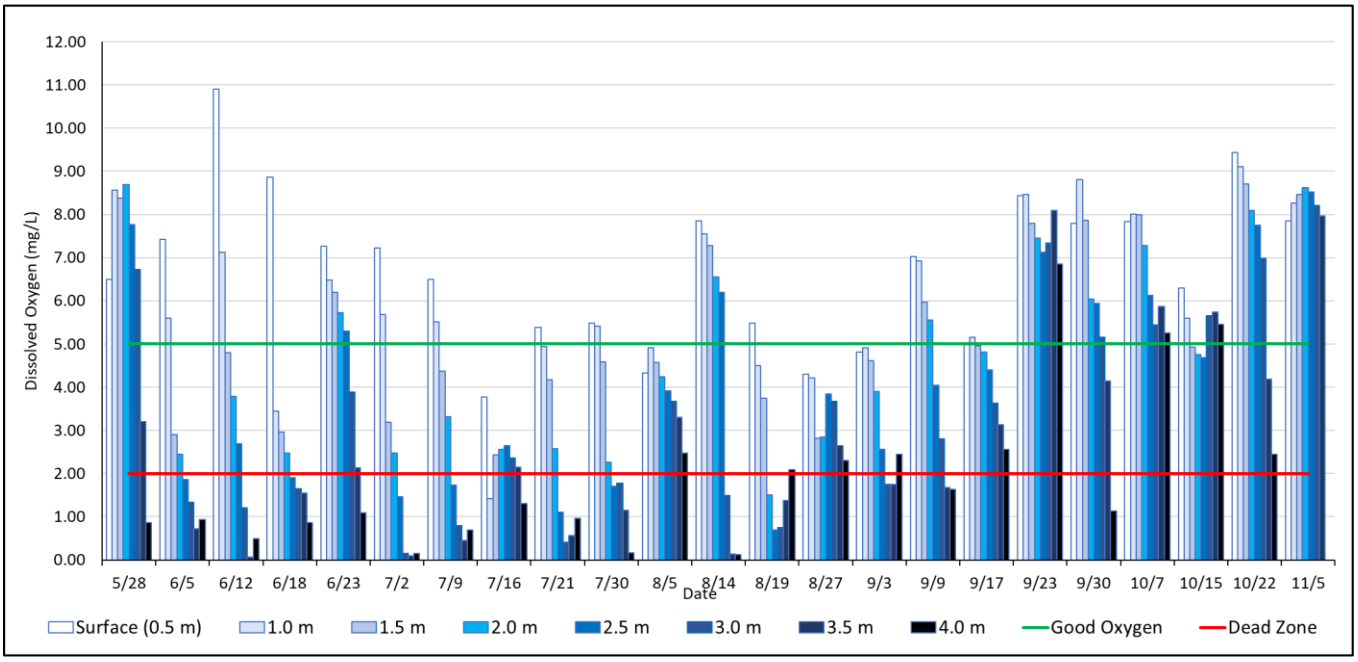

Figure 3. Dissolved oxygen through the water column at Weems Creek #2 in 2020.

- Dissolved oxygen conditions were worse at WC2 than WC1. The upper half of the water column is comparable to WC1, but the lower half of the water column was plagued with dead zones more frequently and intensely.
- Dead zone conditions were recorded on 15 days of monitoring at WC2. Dead zone was constant in summer, occurring on every day of monitoring. Dead zone also occurred frequently in September.
- On 8 days of the 15 recorded dead zones, the dead zone was the majority of the water column, extending from the bottom (4.0 m) to 2.5 meters deep. On the other 7 days, the dead zone was either only on the bottom or was a half meter tall.
- The lowest d.o. measured was 0.07 mg/L on June 12th at 3.5 meters deep.
- Dissolved oxygen was generally better across all depths in the fall, though dead zone was still persistent on the bottom in September. Dissolved oxygen was generally in moderate to good levels for shallower depths in September, and for all depths in October and November.
- The highest reading, 10.90 mg/L, was recorded on June 12th in the surface water. Because this high d.o. was recorded in surface water but dead zone was recorded for the bottom meter of water, an algal bloom may have been present at the surface.

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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. Bottom d.o. measurements were taken with a YSI probe. The probe was lowered until the bottom was felt by slack in the cord. Then the probe was raised to the nearest 0.5 m depth as to not be in the mud (usually 4.0 meters). Bottom d.o. measurements were recorded and displayed for each station on figure 4 below.

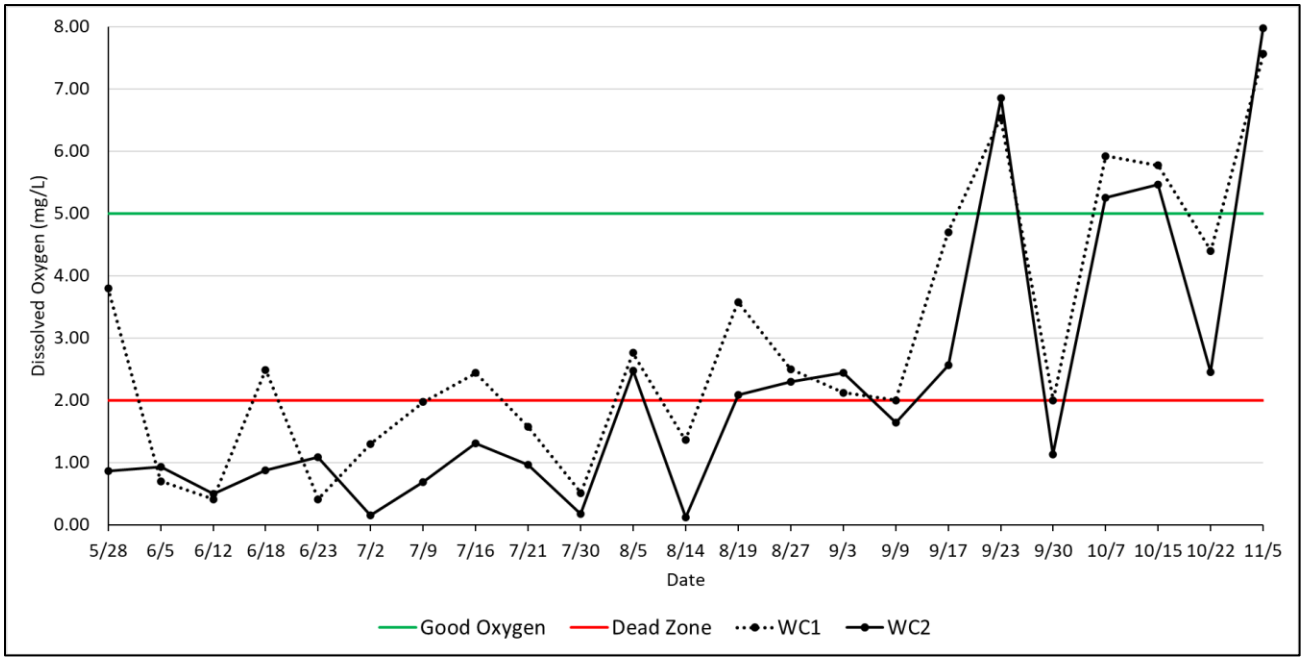

Figure 4. Bottom dissolved oxygen measured at Weems Creek stations in 2020.

- Bottom dissolved oxygen at both stations begins poor, in dead zone for June and July. In August, bottom d.o. varies from moderate levels just above 2.0 mg/L to dead zone.
- A clear increase in bottom d.o. occurs in fall, except for September 30th. Bottom d.o. in mid-September and October were in moderate or good ranges.
- The highest bottom d.o. recorded was on the last day of monitoring on November 5th (7.56 mg/L at WC1 and 7.97 mg/L at WC2).
- Bottom d.o. was consistently better at WC1, except for few instances in June and September. This difference wasn't extreme however and the stations generally followed the same trend through 2020 monitoring.

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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 did not vary much by depth. On figure 5 below, points that fall between the green and red line indicate average daily salinity in the expected mesohaline range.

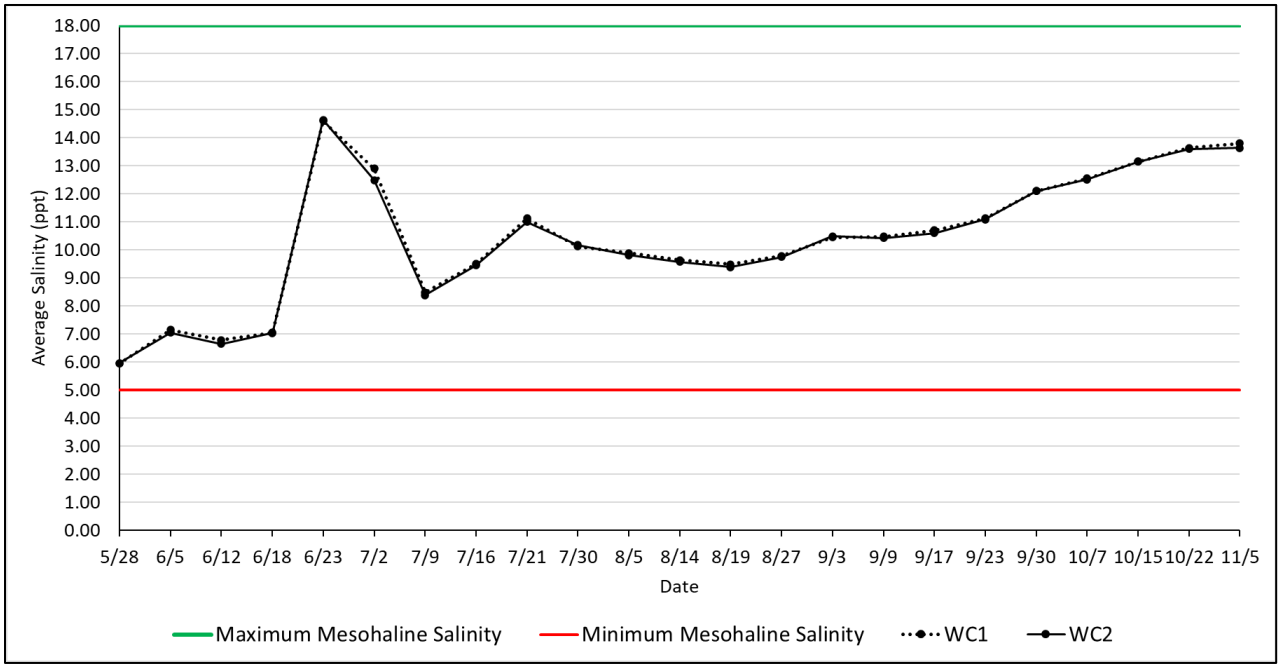

Figure 5. Daily average salinity measured at Weems Creek stations in 2020.

- Average salinity over the 2020 monitoring season fell within the mesohaline range of 5-18 ppt, and steadily increased from spring to fall at both stations. Neither station had a significant difference in average salinity over the monitoring season.
- In May, average salinity was lowest, measuring 5.95 ppt at WC1 and 5.96 ppt at WC2.
- Average salinity was highest on June 23rd, averaging 14.59 ppt at WC1 and 14.63 ppt at WC2.
- Following the peak on June 23rd, average salinity at both stations increased from around 8 ppt to 11 ppt from July to September, and from 11 ppt to 14 ppt from July to November.

[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 6 below. Secchi depths below 0.6 m and above 1.6 m are considered good and bad clarity in mesohaline environments, respectively.

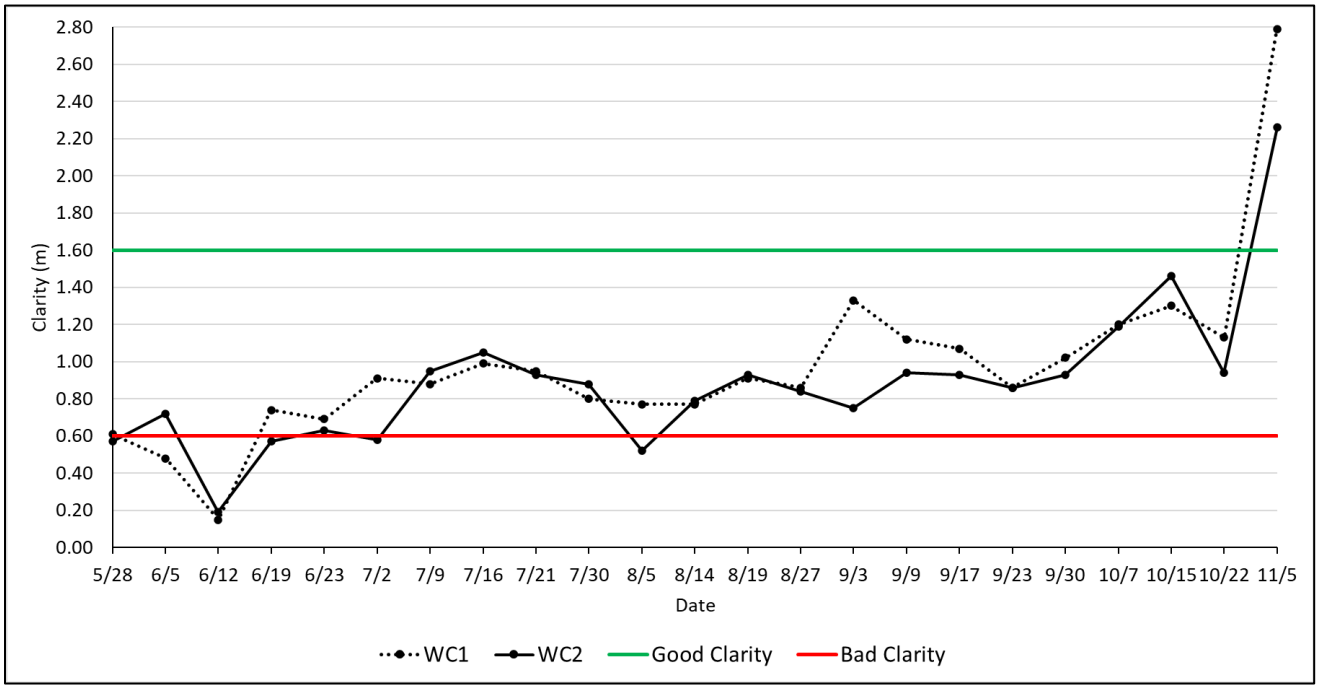

Figure 6. Water clarity at Weems Creek stations in 2020.

- Clarity was generally moderate at Weems Creek stations with few instances of bad clarity in summer and one instance of good clarity in fall.
- Neither station had "better clarity" over the other. From week to week, clarity fluctuated to being better at one station relative to the other, so there is no clear distinction between WC1 and WC2.
- Two large disparities are evident however. On September 3rd, clarity was 0.58 m higher at WC1 than WC2. Additionally, on November 5th, clarity was 0.53 meters higher at WC1 than WC2.
- The lowest clarity in Weems Creek was on June 12th, measuring 0.15 m at WC1 and 0.19 m at WC2.
- The highest clarity in Weems Creek was on November 5th, measuring 2.79 m at WC1 and 2.26 m at WC2.