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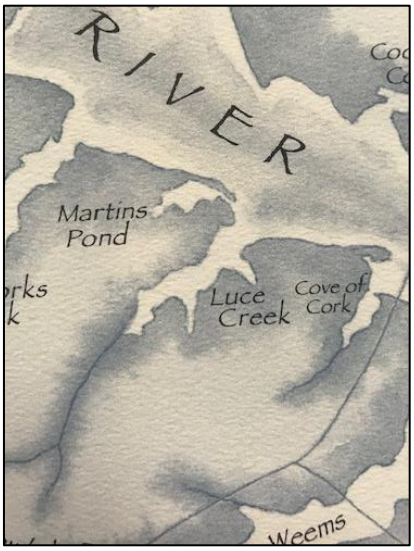
SRA Creek-by-Creek Report

Luce Creek

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

By Emi McGeady, Field Investigator



Abstract

Conditions in Luce Creek were generally poor in the summer but got better by the fall. Dead zones occurred very frequently in summer and plagued most of the water column when measured. This problem subsided in fall when dissolved oxygen was mostly in good levels. Average salinity was in the tolerable range for Severn River life (5-18 ppt) for all of monitoring. Clarity was moderate through most of the monitoring season with few instances of bad clarity in summer.

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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 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 Luce Creek. Luce Creek is a creek located on the mid-Severn River in Annapolis, upriver of the U.S. 50 Severn River Bridge. The areas studied include SRA's water quality monitoring stations titled Luce Creek #1 (LC1) and Luce Creek #2 (LC2) (figure 1).

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

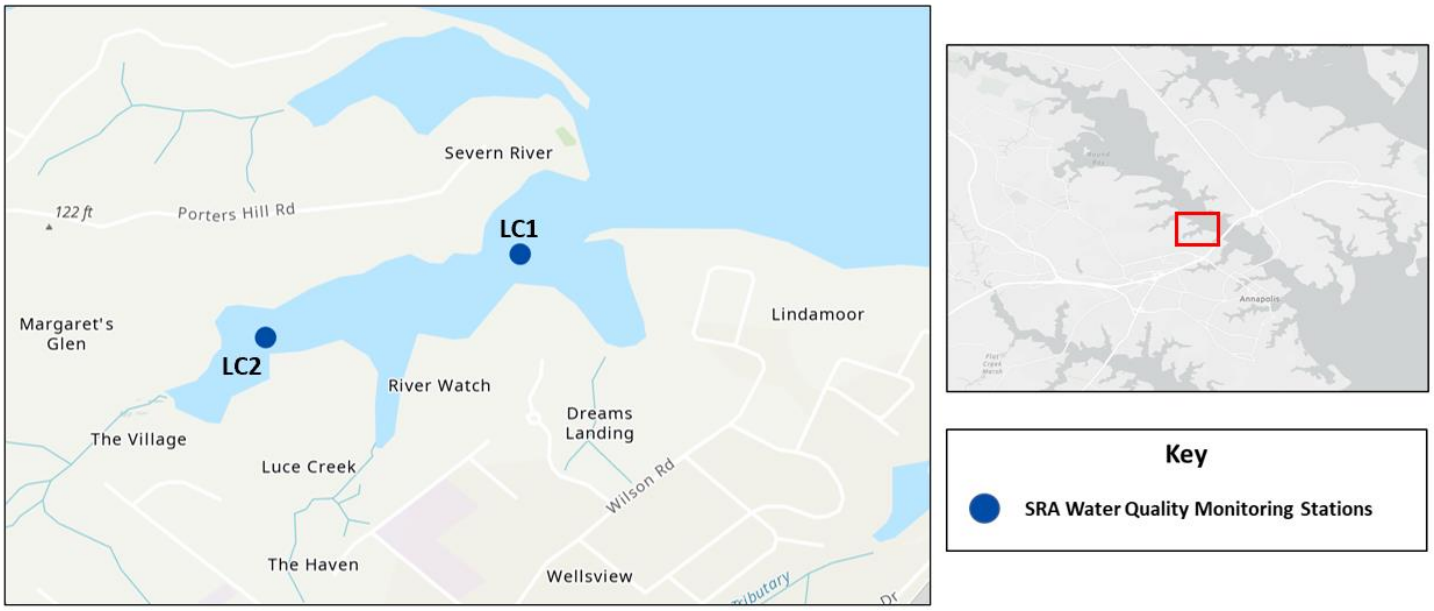

Figure 1. Luce Creek water quality monitoring stations on the middle Severn River.

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EXECUTIVE SUMMARY

Water quality conditions in Luce Creek in 2020 ranged from poor in summer to moderate and good in fall. Dissolved oxygen fell into dead zone conditions (d.o. < 2.0 mg/L) many times at both stations in summer, but more frequently at LC2. When dead zone was measured, the dead zone usually took up most of the water column and readings were very low, usually under 1.0 mg/L. Dissolved oxygen at both stations increased to good levels in the fall. Regardless of season, d.o. was typically lower at LC2, whereas towards the mouth of the creek at LC1, d.o. was slightly better.

Average salinity at both stations 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 (growing from about 6 to 14 ppt). This salinity range is within the tolerance of many Severn River species.

Clarity at all stations was moderate for most of the monitoring season, from May to October. Readings typically ranged from 0.7 m to 1.0 m, though clarity dropped into bad levels (under 0.6 m) three times at both stations in summer. Clarity began increasing for both stations in late October and peaked in November with good clarity of 2.63 m at LC1 and 2.20 m at LC2.

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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 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 Luce Creek #1 generally ranged 3-4 meters deep. Depth at Luce Creek #2 was typically shallower, usually 3 meters deep.

Dissolved oxygen measurements at each depth are displayed on figures 2-3 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.

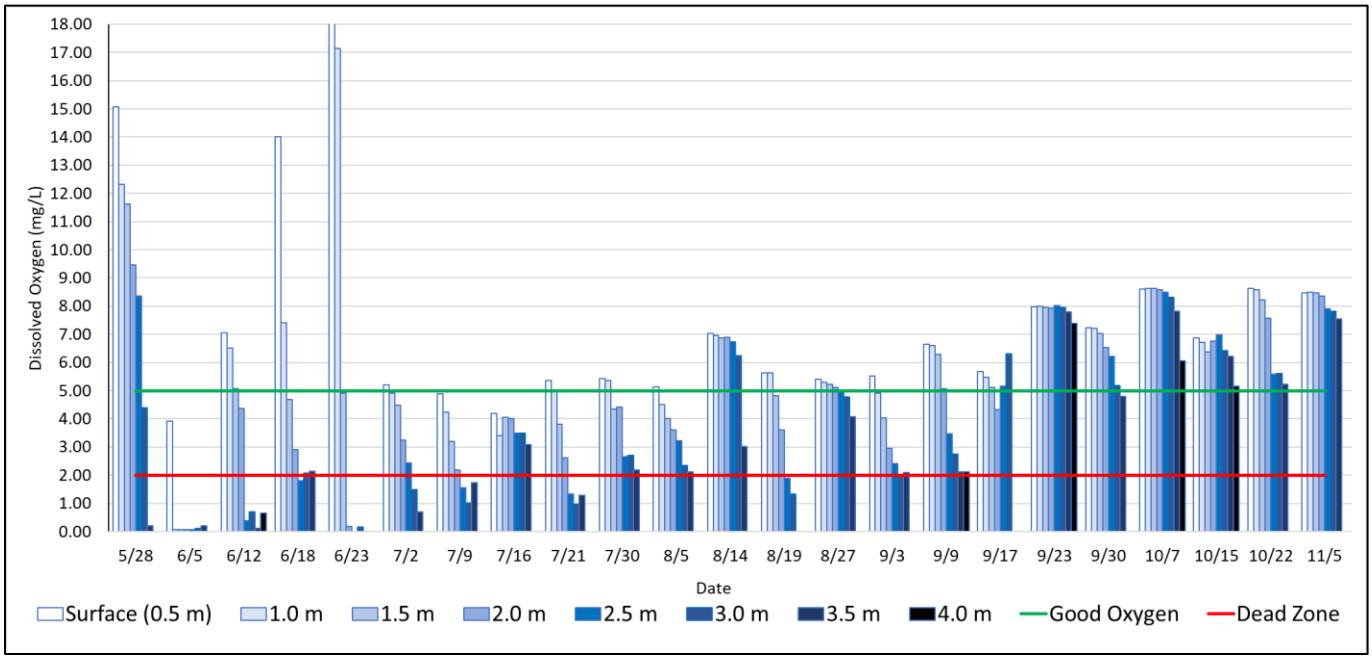

Figure 2. Dissolved oxygen levels through the water column at Luce Creek #1.

- Dead zone was measured frequently at Luce Creek #1, specifically on 9 monitoring days. The dead zone was typically over a meter tall, and took up most of the water column on June 5th, June 12th, and June 23rd.
- The worst dead zone was measured on June 5th with 3 meters of water holding dissolved oxygen less than 1.0 mg/L. Surface water was the only depth where moderate oxygen was measured (3.92 mg/L).

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- In May and June, there was a huge contrast in d.o. in bottom water versus surface water. This is especially seen on June 23rd when surface water held 18.11 mg/L and bottom water held 0.16 mg/L. This high contrast could be indicative of summer temperature stratification or an algal bloom at the surface.
- In September dead zone was no longer measured at Luce Creek #1. Dissolved oxygen in September in the bottom half of the water column was generally moderate (2.0 mg/L < d.o. < 5.0 mg/L), and shallower depths had d.o. in the good range (d.o. > 5 mg/L).
- In October and November, the majority of depths had good oxygen conditions (d.o. > 5.0 mg/L), indicating that river life could be found through the entire water column.

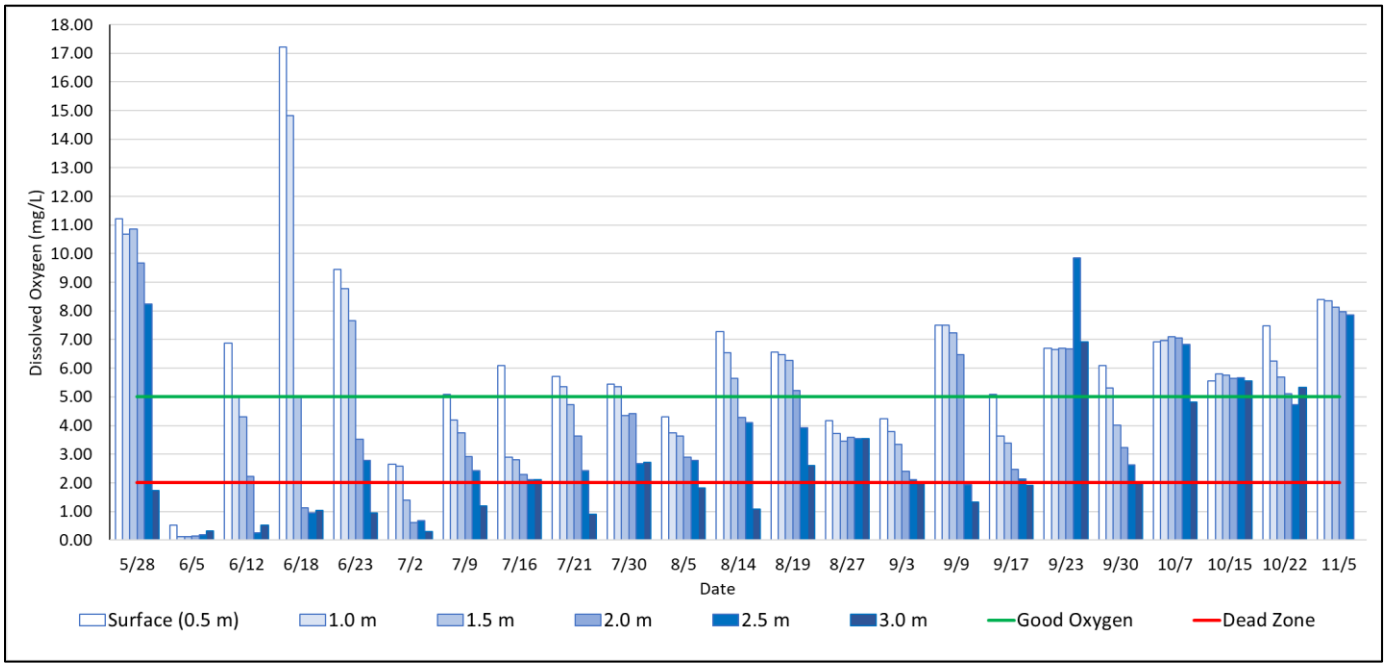

Figure 3. Dissolved oxygen levels through the water column at Luce Creek #2.

- Dissolved oxygen conditions were worse at Luce Creek #2 than Luce Creek #1.
- Dead zone was measured on 13 days of monitoring. Dead zone didn't just occur in the summer, but in September as well, and took up the majority of the water column.
- The worse dead zone occurred on June 5th. The dead zone consumed the entirety of the water column and readings ranged only 0.11-0.53 mg/L.
- Similar to Luce Creek #1, temperature stratification or algal bloom is evident on June 18th. The surface water held 17.22 mg/L and bottom water held just 0.52 mg/L.
- Most depths by October held good oxygen (d.o. over 5 mg/L).

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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 cord. Then the probe was raised to the nearest half meter depth as to not be in the mud. Bottom d.o. measurements were recorded and are displayed for each Luce Creek station on figure 4 below.

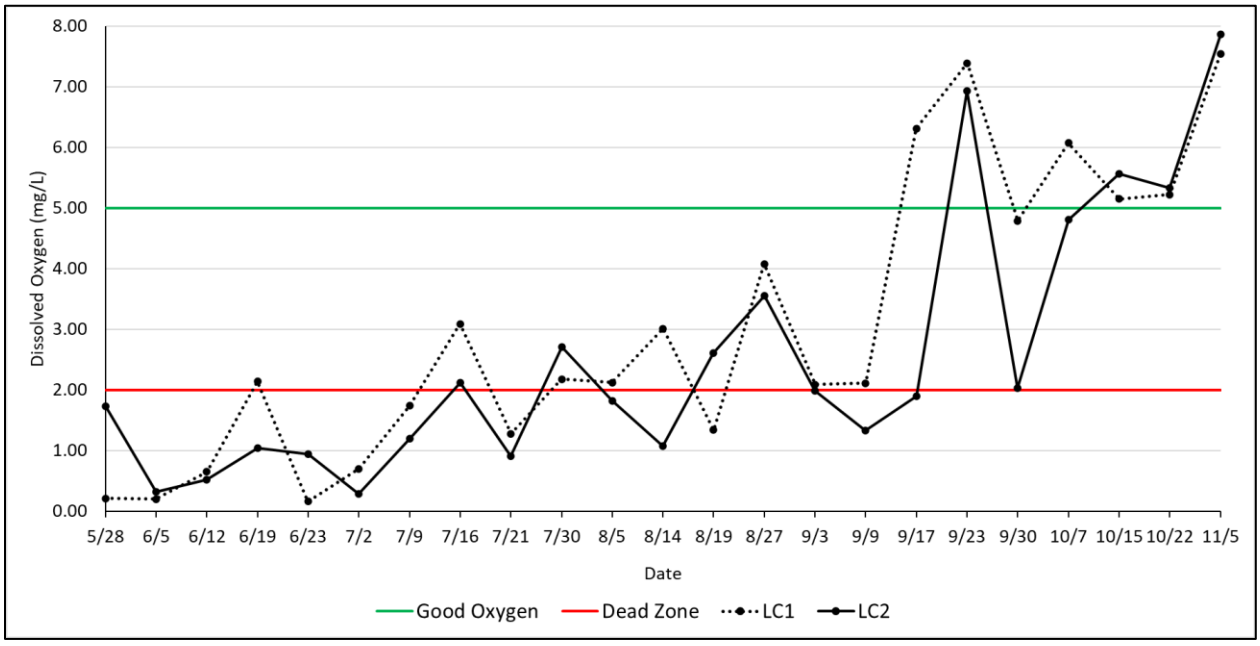

Figure 4. Bottom dissolved oxygen measured at Luce Creek stations in 2020.

- Bottom dissolved oxygen followed a similar trend at both stations. Bottom d.o. was typically dead zone in summer and then began increasing to good levels in fall.
- Bottom dissolved oxygen was better at LC1 as dead zone on the bottom only occurred from May to August, rather than May to September at LC2.
- Bottom dissolved oxygen at LC1 was freqeuntly dead zone from May to August but had instances where bottom d.o. was measured in moderate ranges just above 2.0 mg/L. Bottom d.o. then jumped up to good levels on September 17th, where it stayed in sufficient levels for river life into November.
- Bottom dissolved oxygen at LC2 was frequently dead zone from May to September. Bottom d.o. didn't reach good levels at LC2 until September 23rd but then it collapsed the following week on September 30th. Bottom d.o. then rebounded on October 7th and was in good levels for the remainder of 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. 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 5 below, points that fall between the green and red line indicate average daily salinity in the expected mesohaline range.

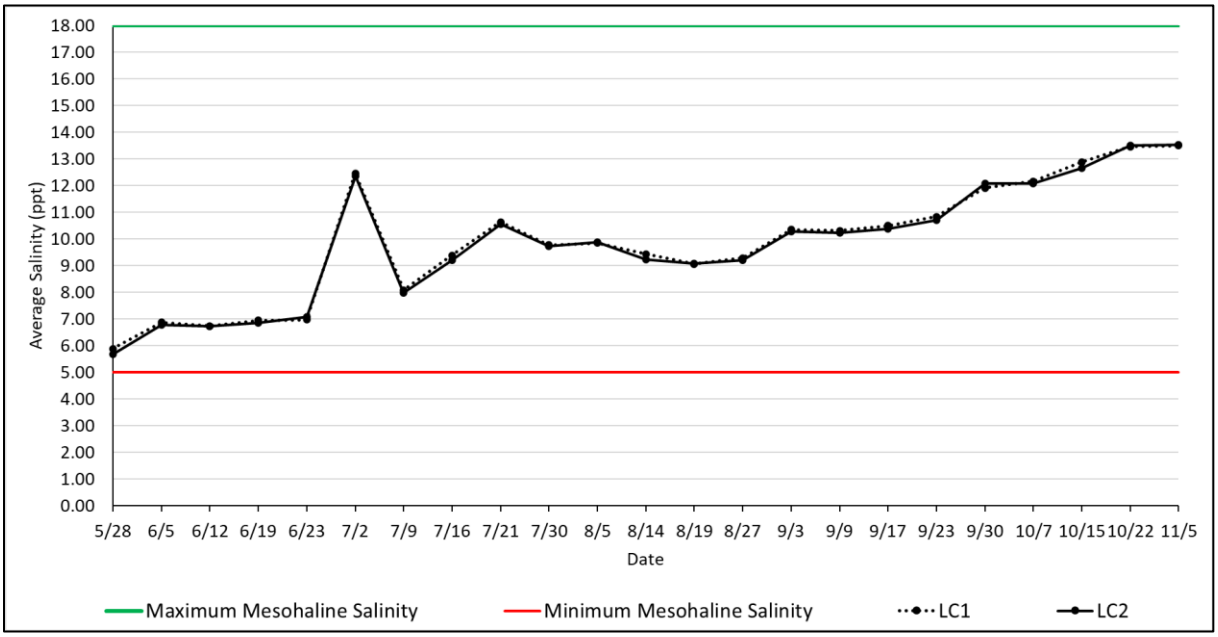

Figure 5. Average salinity measured at Luce Creek stations in 2020.

- Average salinity over the 2020 monitoring season fell within the mesohaline range of 5-18 ppt.
- On May 28th, average salinity was lowest, measuring 5.88 at LC1 and 5.68 ppt at LC2.
- Average salinity then jumped up on July 2nd, measuring 12.46 ppt at LC1 and 12.35 ppt at LC1. The following week it fell to 8 ppt then steadily increased for the remainder of monitoring at both stations.
- At both stations, average salinity was highest in November, averaging 13.49 ppt at LC1 and 13.53 ppt at LC2.
- Both stations had very similar average salinities over the course of the monitoring season and never differed by more than 0.24 ppt.

[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. Good clarity for mesohaline environments is 1.6 meters (green line) while bad clarity is any reading less than 0.6 meters (red line).

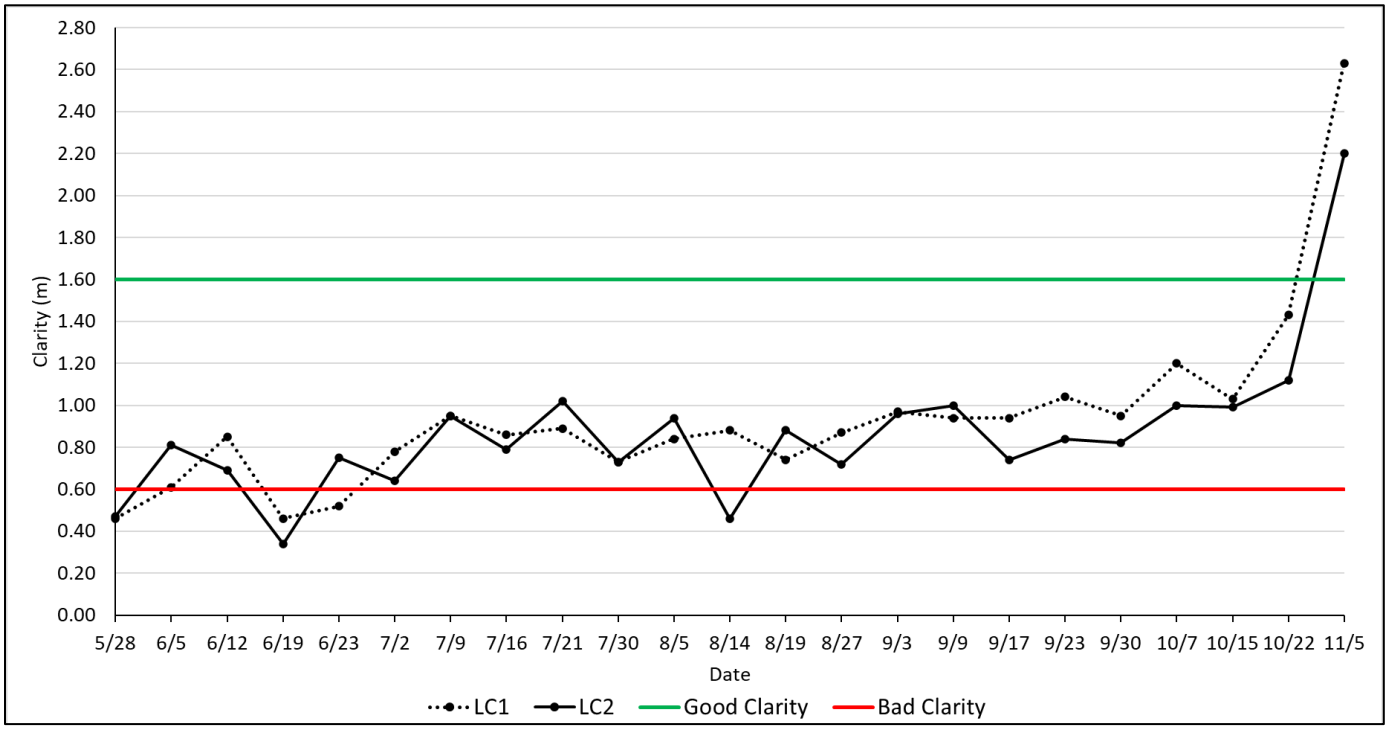

Figure 6. Water clarity at Luce Creek stations in 2020.

- Clarity was moderate at both stations with few instances of bad clarity in summer and one instance of good clarity in November.
- Clarity was bad at LC1 on May 28th, June 19th, and June 23rd, measuring 0.46 m, 0.46 m, and 0.52 m, respectively.
- Clarity was bad at LC2 on May 28th, June 19th, and August 14th, measuring 0.47 m, 0.34 m, and 0.46 m, respectively.
- Neither station had the "better clarity" through the summer as both stations' readings fluctuated in moderate ranges week to week. In September however we begin to see consistently lower clarity at LC2, though clarity is increasing at both stations.
- Clarity reached good levels at both stations on November 5th. These readings were 2.63 m at LC1 and 2.20 m at LC2.