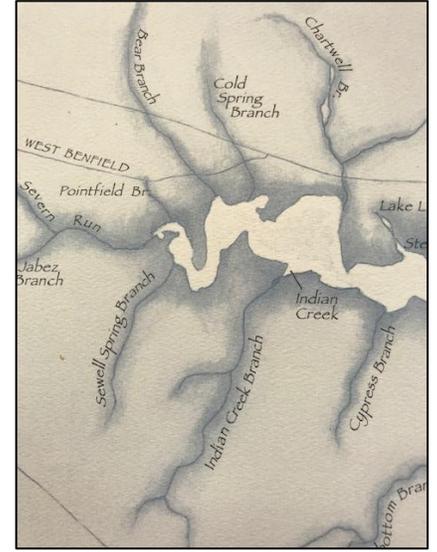


SRA Creek-by-Creek Report Indian Landing

2020 Dissolved Oxygen, Salinity, and Clarity Analysis

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Abstract

Water quality was consistently poor at Indian Landing in 2020. Dead zones were very frequent, occurring for 65% of monitoring, and for 11 consecutive weeks from July to October. Salinity was fresher compared to downriver stations as it is continually impacted by inputs from Severn Run. Clarity was also bad here, as most readings were under 0.5 meters. Bad clarity was caused by persistent algal blooms and stormwater runoff.



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 throughout 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, at Indian Landing. Indian Landing is SRA’s water quality monitoring station along the shores of the Point Field Landing and Ben Oaks communities located towards the headwaters of the Severn River (figure 1). Also located in the headwaters is a historic location for yellow perch spawning (figure 1). The viability of the Severn River yellow perch population is discussed later in this report and will be further investigated during spring yellow perch larval monitoring in 2021.

Monitoring at Indian Landing occurred weekly from May 27th to November 4th in 2020. This resulted in a total of 23 monitoring days and 226 volunteer hours.

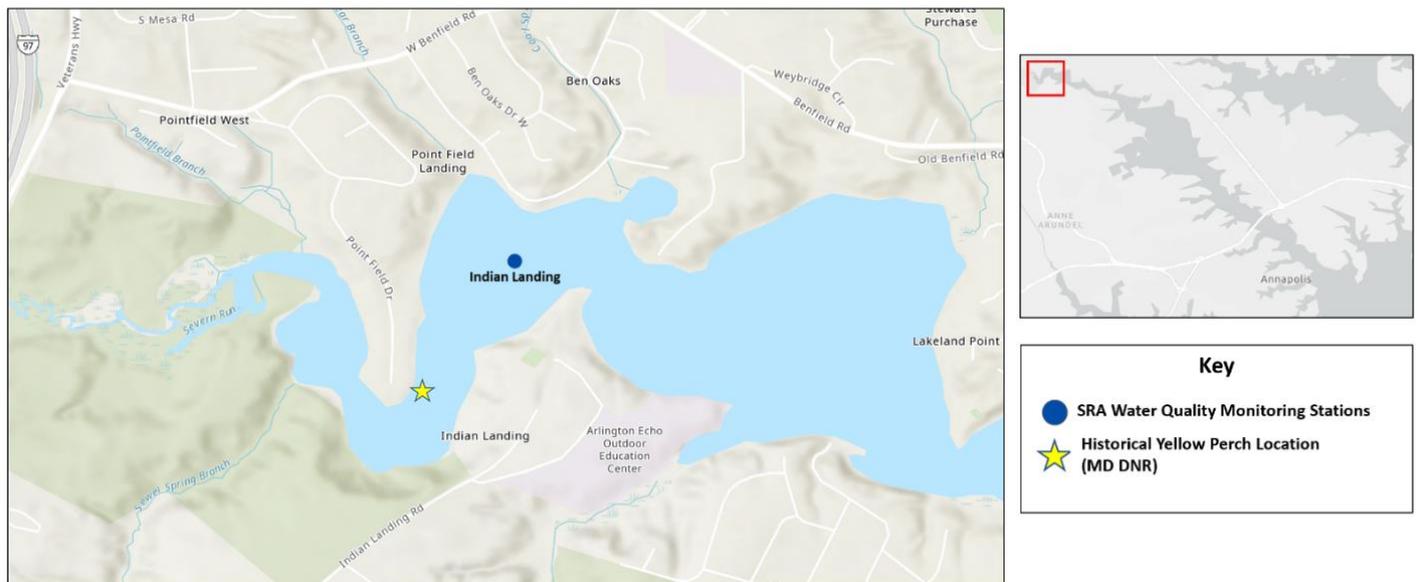


Figure 1. Indian Landing water quality monitoring station located in the Headwaters of the Severn River.



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EXECUTIVE SUMMARY

In 2020, water quality at Indian Landing was generally poor, and the worst of the river's mainstem water quality monitoring stations. We observed dead zones (dissolved oxygen < 2.0 mg/L) through most of the monitoring season. A dead zone on the bottom persisted for 11 weeks from July through October.

Salinity on average fell within the mesohaline range of 5-18 ppt, but surface water was often more fresh than downriver stations. This fresher salinity is due to its proximity to freshwater inputs from Severn Run. A historic location for yellow perch exists here, but salinity is too high to support successful reproduction (egg salinity is optimal at 2 ppt).

Clarity was also poor in comparison to downriver stations. Clarity was highest at 0.98 m, but most readings fell below 0.5 m (bad clarity is considered under 0.6 meters). Low clarity resulted from multiple mahogany tide algal blooms fueled by excess nutrients from stormwater runoff due to the widespread impervious surfaces surrounding this station. Consistently poor clarity, and frequent and persistent dead zone conditions also arose from upstream construction work on Bear Branch.

ANALYSIS

Water Column Dissolved Oxygen

River life, including oysters, fish, and crabs, prefer dissolved oxygen levels above 5.0 mg/L (depicted by the green line on the graph 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 line on the graph below).

On each day of monitoring at Indian Landing, 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. Depth at this station was typically very shallow, only 1.5-2.0 meters deep.

Figure 2 displays the high prevalence of dead zone conditions through the entire water column at Indian Landing station. The lighter bars represent the dissolved oxygen in surface water, with the darker bars representing dissolved oxygen at deeper depths. The red X symbols indicate days during the 2020 monitoring season that dead zone conditions were recorded anywhere in the water column.

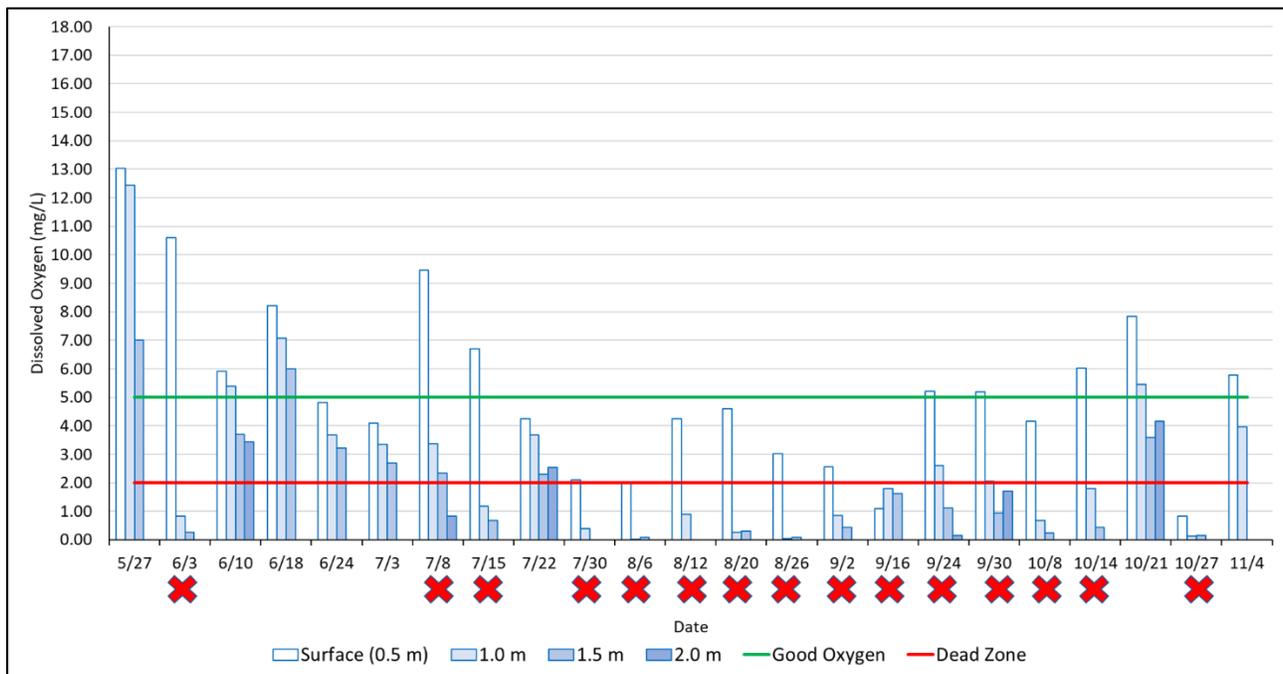


Figure 2. Dissolved oxygen levels through the water column at Indian Landing.

- Of the total 23 days monitored in 2020, dead zone conditions were recorded on 15 days, totaling 65% of the time.
- The dead zone existed throughout most of the water column on those days, and sometimes even extended throughout the entire water column (8/6, 9/16, and 10/27).
- The lowest dissolved oxygen reading of 0.01 mg/L was recorded in 1.0 meter deep on August 6th and is considered anoxic.

- The best oxygen readings occurred on May 27th and June 18th, where dissolved oxygen at every depth was above the good oxygen level of 5.0 mg/L.
- The highest dissolved oxygen reading recorded was in the surface water on May 27th (13.04 mg/L).
- For 4 consecutive weeks, moderate to good oxygen levels (>2.0-5.0 mg/L) were observed through the entire water column (6/10-7/3).
- Dead zone was more likely to occur in late summer and fall, as a persistent dead zone lasted for 11 consecutive weeks from late July to October (7/30-10/14).

Bottom Dissolved Oxygen

Measuring dissolved oxygen on the bottom is important for understanding conditions for sedentary or less mobile creatures that cannot move through the water column and escape dead zone conditions, such as oysters, mollusks, and other benthic organisms. Oysters currently do not live in this location on the Severn River, but tracking dissolved oxygen on the bottom is still important in recognizing future possible oyster restoration sites, and understanding how benthic creatures may be affected.

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 0.5 m depth as to not be in the mud. Bottom d.o. measurements were recorded and displayed for each Back Creek station on figure 3 below.

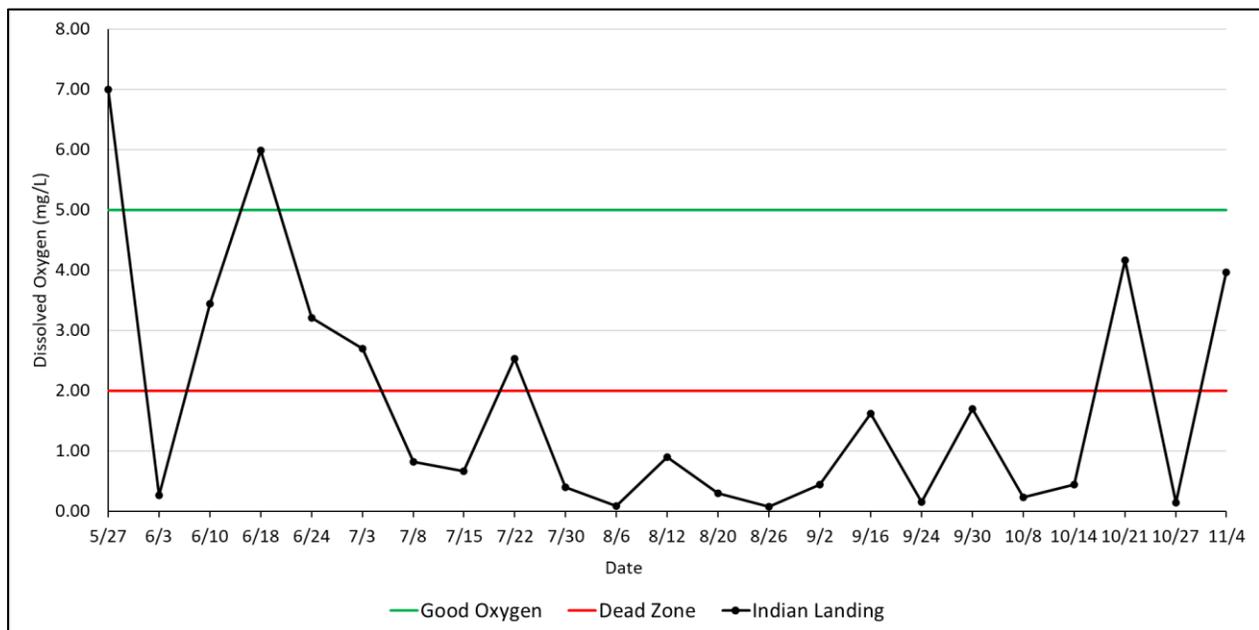


Figure 3. Bottom dissolved oxygen measured at Indian Landing in 2020.

- Dead zone conditions on bottom of the river were recorded on 15 of the 23 monitoring days (65%).
- The dead zone on the bottom was constant for 11 weeks from late July through October, and averaged 0.58 mg/L.
- The lowest bottom dissolved oxygen reading recorded was 0.08 mg/L on August 26th.

- Bottom readings barely fell in the moderate to good range above 2.0 mg/L. Moderate to good dissolved oxygen was recorded most often in June, and only twice in the fall.
- Of the 8 times bottom dissolved oxygen reached above 2.0 mg/L, bottom dissolved oxygen only reached the good level of 5.0 mg/L on 2 days. These readings were 7.0 mg/L on May 27th, and 5.99 mg/L on June 18th.

Surface 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) (Chillrud 2020). Instead the typical salinity range, or amount of dissolved salt in the water, of the Severn River is mesohaline (5-18 ppt). 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, decreased reproduction and growth, and lessened survival.

Salinity measurements were taken weekly with a YSI probe. The probe was lowered to the deepest depth where the first measurement was recorded. The probe was then raised through the water column, taking measurements at every subsequent half meter. Points that fall between the green and red line indicate readings within the typical mesohaline range.

Indian Landing is a unique location in that it is located in the headwaters of the Severn River, and therefore receives freshwater inputs from Severn Run and Bear Branch. Because of this, salinity is lower than downriver stations and historically, yellow perch have spawned here and in the fresher Severn Run, as they migrate to fresher salinities to lay their eggs (MD DNR). The salinity tolerance of yellow perch eggs is 2-13 ppt, though egg viability diminishes above 2 ppt (yellow line on graph below) (Harmon 2011). Egg chains are found in the surface waters so surface water salinity is displayed on figure 4 below.

Currently yellow perch reproduction is not successful in the Severn River due to many complex interactions including increasing salinity in spawning areas, poor dissolved oxygen in juvenile habitat, increased flow from development disturbing egg chains, and environmental contaminants that interfere with normal hormone release and egg development (MD DNR). Without further intensive investigation it is difficult to know if yellow perch spawning and reproduction will be successful in the Severn River in the future. Nevertheless it is important to track salinity to better understand this possibility.

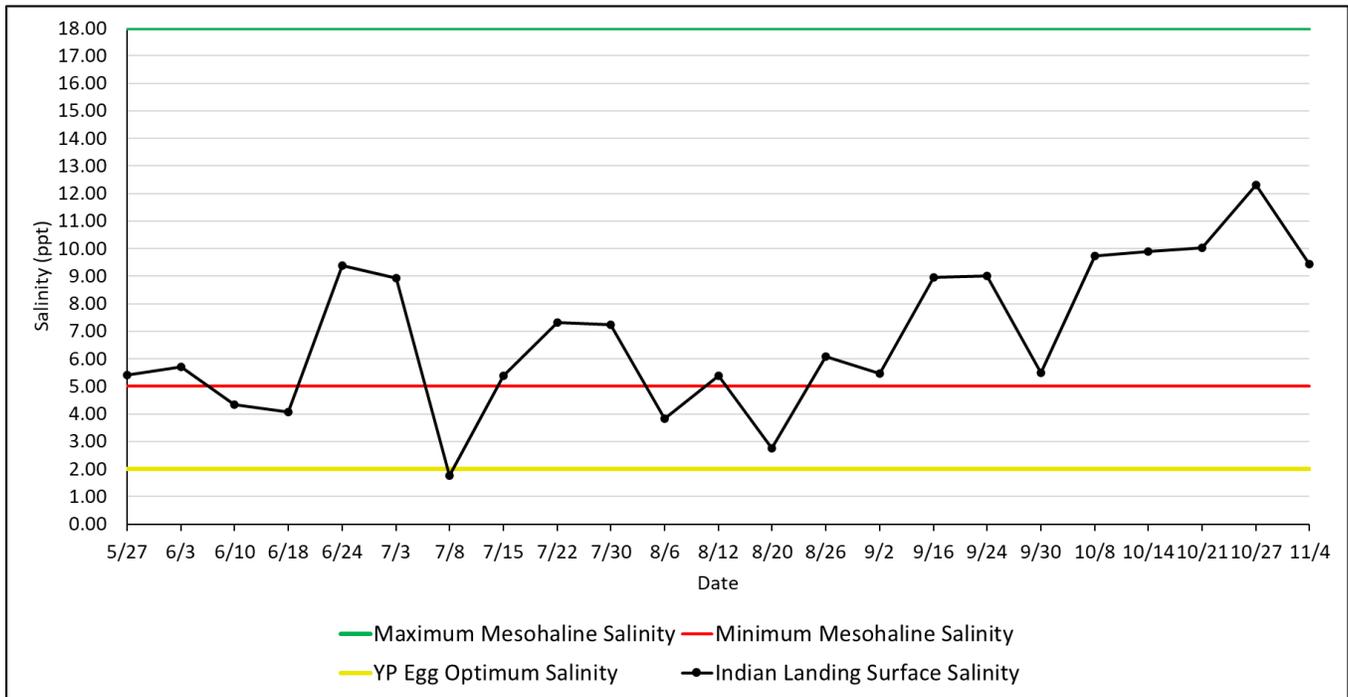


Figure 4. Surface salinity measured at Indian Landing in 2020.

- Salinity in surface water was generally fresher than deeper water, and dipped to optimal yellow perch egg salinity once in 2020: July 8th when salinity was 1.77 ppt.
- Surface salinity at Indian Landing was much fresher than downriver stations. Surface salinity was below the mesohaline range 5 times in 2020, whereas downriver stations' salinity was typically always within the mesohaline range.
- The highest surface salinity recorded was 12.30 ppt on October 27th.
- Surface salinity was mostly below 8 ppt in summer, except for a peak in late June. This peak in June was then followed by a sharp decline in July. Starting in late August, and into the fall months, surface salinity steadily increased. This salinity increase was likely due to less freshwater inputs as summer rainfall subsided.

Bottom Salinity

Just as tracking dissolved oxygen on the bottom is important for understanding potential abiotic stress to oysters and other benthic organisms, so is tracking bottom salinity. Sedentary benthic organisms and submerged aquatic vegetation cannot escape salinity outside of their tolerance ranges. Oysters thrive in salinities of 10-28 ppt (Chesapeake Bay Program). SAV grows in fresher salinity; sago pondweed prefers 0-12 ppt, and redhead and widgeon thrive in salinities 5-10 ppt and 5-15 ppt respectively (Bergstrom et. al., 2006).

Submerged aquatic vegetation is also spawning and juvenile habitat for yellow perch (egg chains are often found strewn across SAV). If we want to track possible reproduction success we need to track the conditions that allow SAV to grow. Bottom salinity was tracked weekly and is displayed below (figure 5).

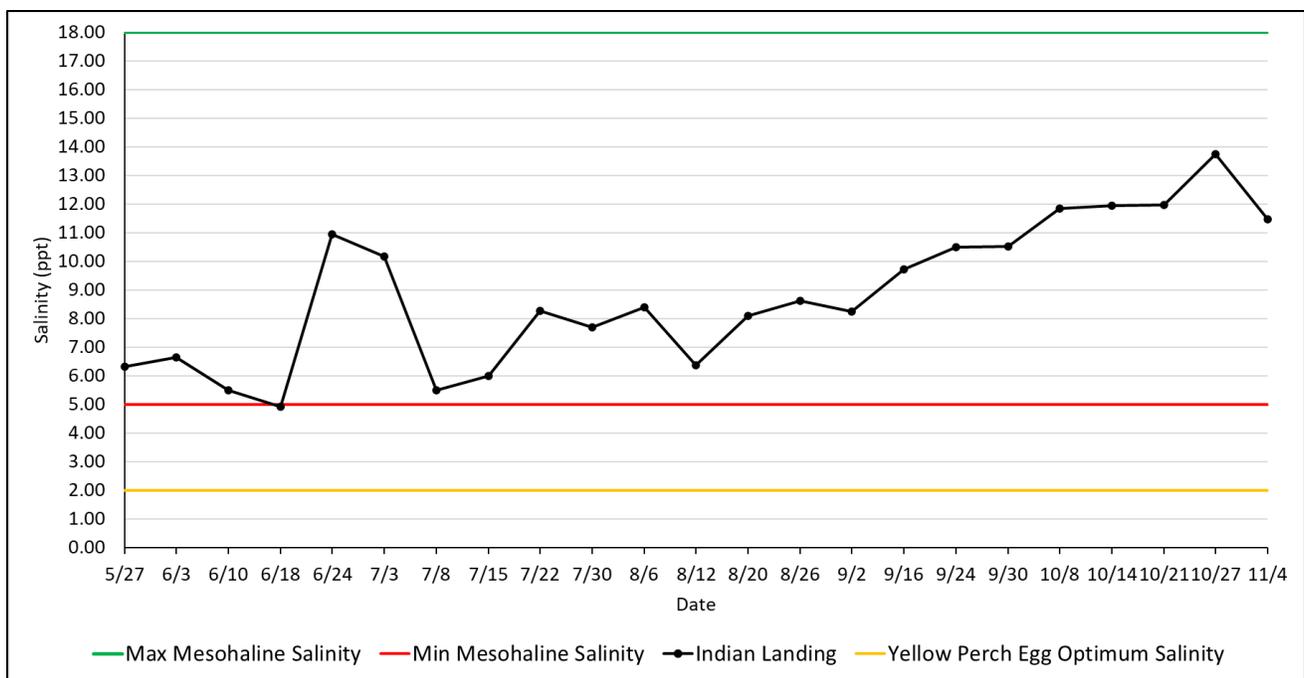


Figure 5. Bottom salinity measured at Indian Landing in 2020.

- Bottom salinity remained in the mesohaline range of 5-18 ppt for the entire 2020 monitoring season, except for June 18th when the lowest bottom salinity recorded was 4.93 ppt.
- Despite a bottom salinity peak from June 24th to July 1st, bottom salinity tended to slightly increase over the monitoring season. Salinity began low at 6.33 ppt and steadily grew to 13.74 ppt in October.
- Bottom salinity was in the correct ranges to support many SAV species, though other factors limit SAV growth at this location including low clarity from suspended sediment and algal blooms.

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 suitable 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 Secchi readings are over 1.6 meters. Bad clarity is any Secchi reading under 0.6 meters.

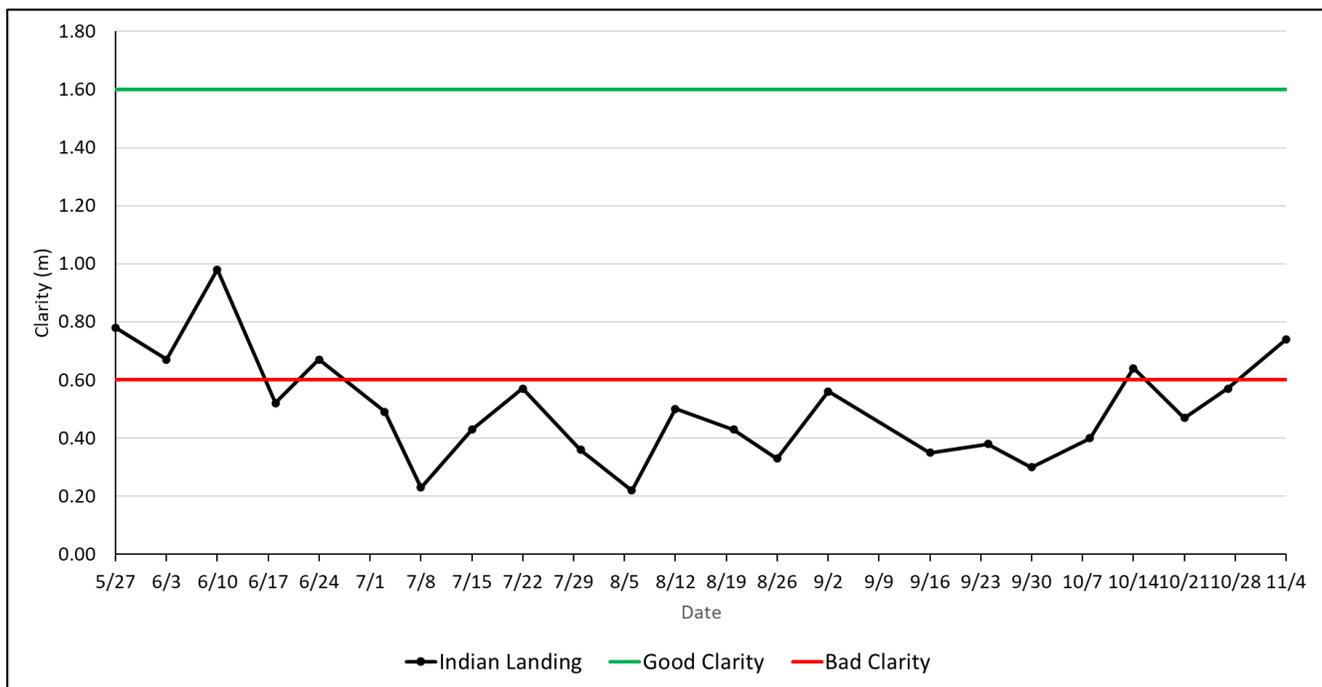


Figure 6. Water clarity measured at Indian Landing.

- Clarity ranged from 0.22 m to 0.98 m in 2020. Clarity was bad almost every week except for May and early June and once in October and November.
- Clarity was generally higher at the beginning of the monitoring season in spring and early summer (0.7-1.0 m) and towards the end of monitoring in November (0.7 m), but it was never good (over 1.6 m).
- July, August, and September were the worst months for clarity; most readings fell below 0.5 m.
- Indian Landing had one of the worst overall clarity trends of SRA water quality monitoring stations.

Excess nutrients and sediments from stormwater runoff due to widespread impervious surfaces from Severna Park, and along the Severn Run watershed to Ft. Meade, is the likely cause of such consistently poor clarity readings at Indian Landing station. We visually saw first-hand the impact of this increased runoff as we observed a mahogany tide bloom in early fall. A tell-tale sign of the microscopic algae, *Prorocentrum minimum*, that causes the mahogany tide, is water that is a rusty-red color. These algal blooms decrease light



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reaching submerged aquatic vegetation and contribute to fish kills when blooms die and decay, so it is important to track them on the Severn River (Maryland Department of Natural Resources). Additionally, clarity was impaired due to upstream work on Bear Branch. Communities frequently observed muddy erosion and silting in around community piers.

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