BUENA VISTA CREEK 2022 ANNUAL REPORT

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Background

In the spring of 2019 Preserve Calavera created a program, the North San Diego County Watershed Monitoring Program (NSDCWMP) to carry on the decade-long work of San Diego Coastkeeper (SDCK) to assess the health of local surface waters. The three watersheds of Carlsbad's lagoons, all of which are part of the Carlsbad Hydrologic Unit, are evaluated for a number of parameters, physical, chemical and biological on a bimonthly basis.

NSDCWMP is an all-volunteer citizen science effort with a leadership management team comprised of two Preserve Calavera board members (also leaders of the Buena Vista Creek (BVC) and Agua Hedionda Lagoon monitoring teams) and a representative from and leader of the Batiquitos Lagoon team. This effort wouldn't be possible without the dedication of all our volunteers: the BVC field team (Kathy Parker, Dan Keddy, Michelle Colvin) and lab workers (Karen Merrill, Janell Cannon, Scott Engel, Ellen Bartlett, Brennon Flahive and Karen Wytmans). Our technical advisors are Erick Burres (CA Waterboard), Chad Loften (San Diego Regional Water Quality Control Board, and Brennon Flahive (retired Environmental Compliance Director at South Orange County Waterwater Authority). Data is posted at www.preservecalavera.org and will be on the CEDEN website and shared with SDRWCB and the city of Carlsbad, Oceanside and Vista. The program began testing in July 2019.

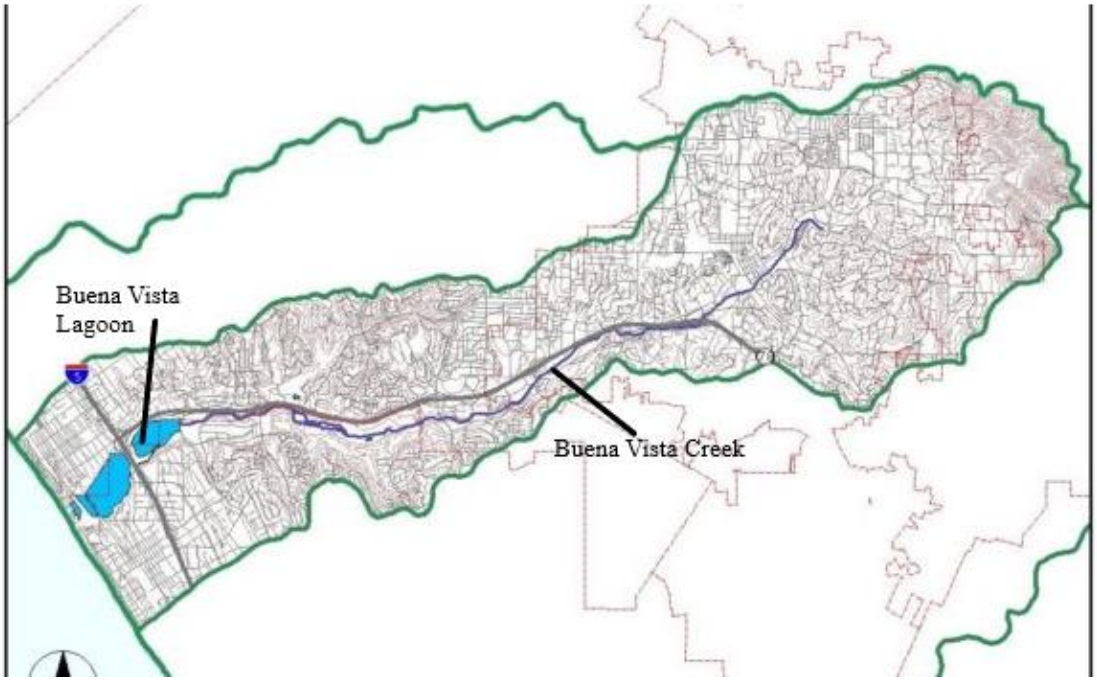


Figure 1 – Buena Vista Creek Watershed[1]

Buena Vista Lagoon which is part of both Oceanside and Carlsbad is fed by Buena Vista Creek whose headwaters are on the western slopes of the San Marcos Mountains. Buena Vista Creek is the only creek feeding Buena Vista Lagoon which opens to the Pacific Ocean. Currently, due to a weir put in place in the 1940s near the mouth of the lagoon, it is freshwater and in a steady

state of decline. In May 2020, the Final Environmental Impact Report prepared by The San Diego Association of Governments (SANDAG) was adopted by their Board of Directors. The consequence is that the lagoon will be returned to its historic saltwater state when funding becomes available.[2]

For 10 years SDCK monitored this watershed bimonthly, ending in December, 2018. Data for 2009-2016 is posted on the California Environmental Data Exchange Network (CEDEN). For calendar years 2017 and 2018 data has been provided to our program by SDCK. During the last year that SDCK produced annual reports for their watersheds, 2016, Buena Vista Creek's water quality was rated as 'fair'. NSDCWMP has not yet created a similar scorecard to assess the overall health of the watershed.

The purpose of this annual report is to 1) interpret the health of Buena Vista Creek for the testing period in 2022 and 2) look at historic trends (2019-present). Each parameter will be evaluated for anomalies and trends and the overall state of the watershed will be summarized based upon these results. Monitoring was carried out in January, March, May, July, September and November of 2022.

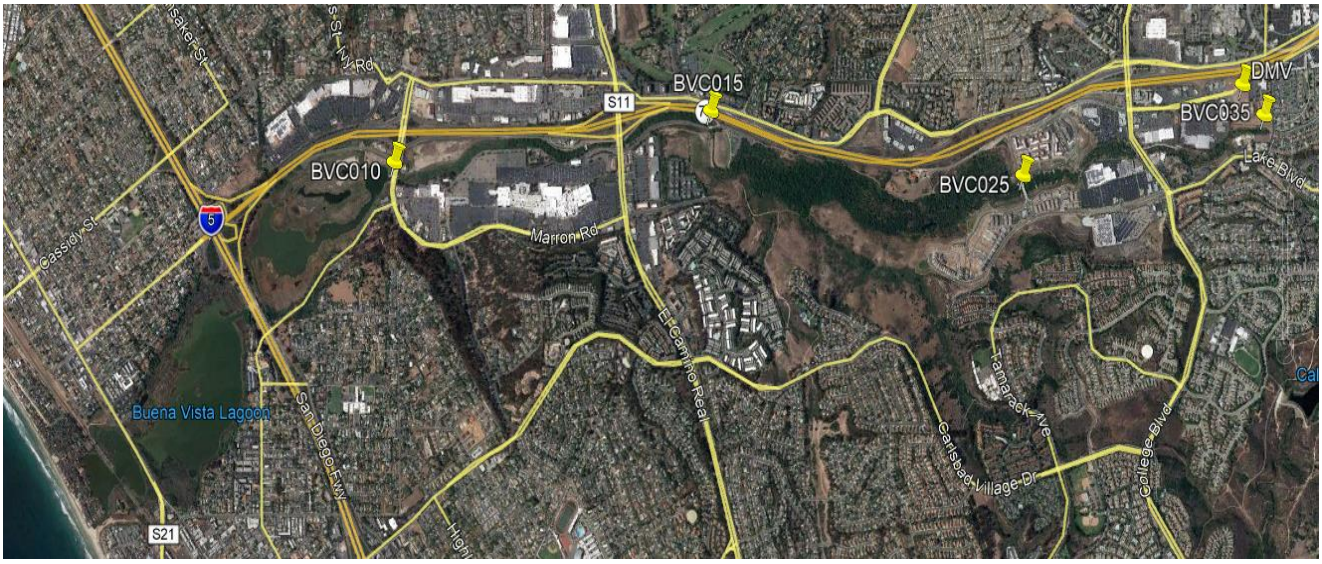
[1]https://scwrp.org/projects/buena-vista- icreek-watershed-plan/
[2]https://bvaudubon.org/bv-lagoon-enhancement/

Sampling Sites

The Buena Vista Creek team sampled the 4 sites along the creek (BVC010, BVC015, BVC025 and BVC035). The site identifications in the map below are the same as those used by SDCK at various times between 2009-2018. Site BVC025 within the Preserve housing development (formerly Quarry Creek) was added to our sampling regimen early in 2022 to monitor surface water quality in areas of significant unhoused encampments; we only sampled for bacteria at that site.

During 2022 we returned to full in field measurements (dissolved oxygen, air and water temperatures and conductivity) once COVID restrictions were lifted. Of note to be discussed below there was a significant rain event during the September sampling.

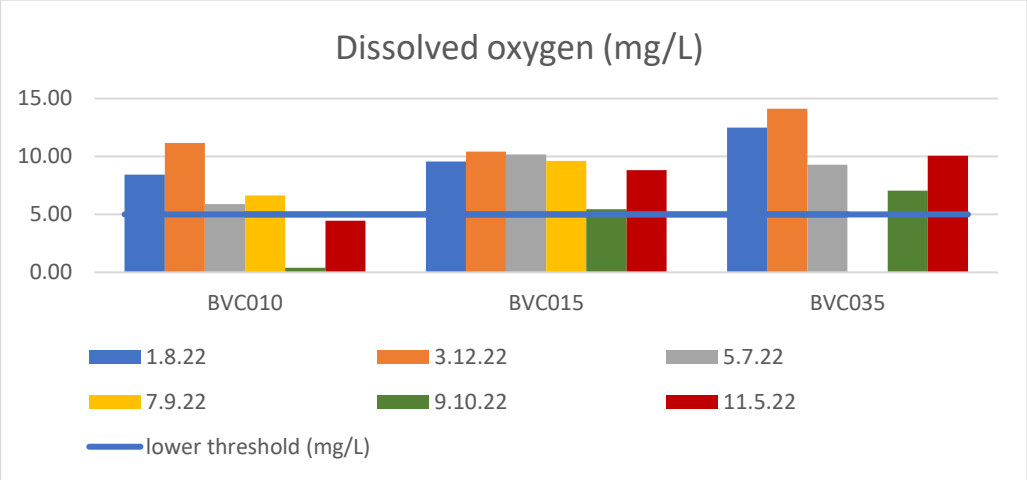
Figure 2 - Buena Vista Creek sampling sites



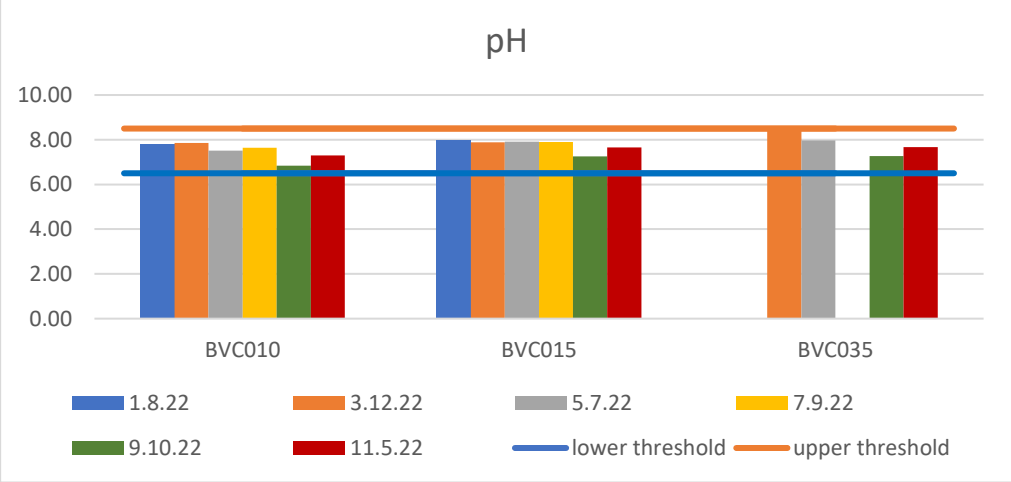
Field Parameters

Our field teams of 3-5 trained volunteers visit our sites within each watershed where water samples are collected for laboratory analysis and *in situ* measurements made for dissolved oxygen, conductivity, air and water temperature, and pH. One field sample is filtered for nutrient tests (reactive phosphorus and nitrate) and the other used for bacteria, turbidity, and total phosphorus measurements. Part of the filtered sample is added to a small bottle containing concentrated HCl (to lower the pH to ~2) for the ammonia assay.

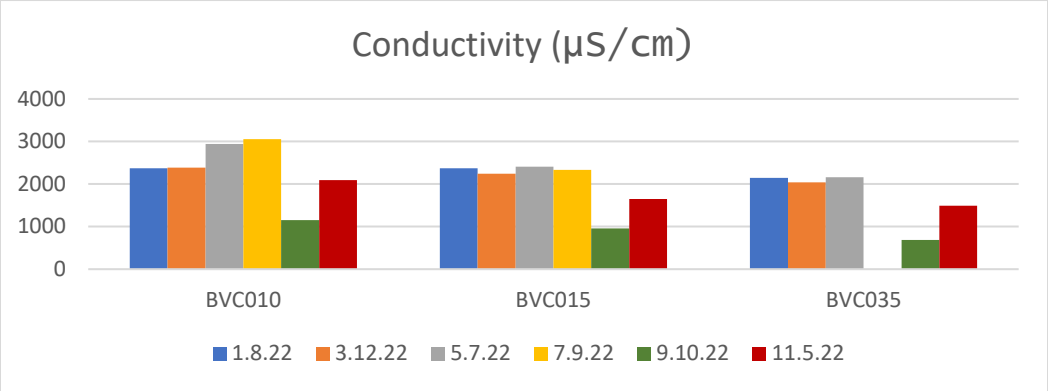
Dissolved oxygen (DO) was measured at 3 sites and generally above the San Diego Basin Plan[3] threshold of 5.0 mg/L. Because only grab samples at BVC025 were taken for bacterial analysis, we have no data for that site. In July, site BVC035 was completely blocked off, hence, we have no data for July 9. DO was lowest at all sites in September with elevated water temperatures (22-24°C) compared to July (19-25°C) which coincides with lower gas content in the water. At the head of the lagoon where water flow is typically its lowest Sept. DO was <1.0 mg/L with dead fish floating in the vicinity. The cause of this deoxygenated water is unknown.



The pH measurements in the field continued to be within acceptable limits.



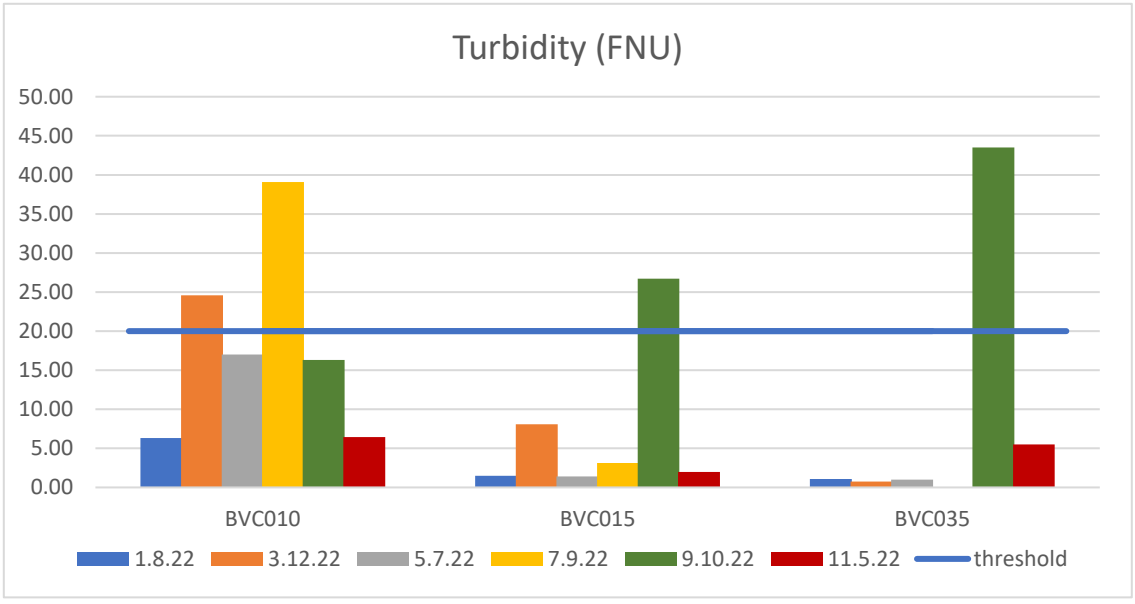
Conductivity fluctuated between about 800 and 3000 µS/cm. You can see in the graph that with the rain event in September, conductivity dipped at all sites presumably from excessive runoff diluting the minerals in the water. There is no threshold for conductivity, it merely reflects the amount of dissolved minerals in the water. These readings are quite similar to 2021.



Laboratory tests

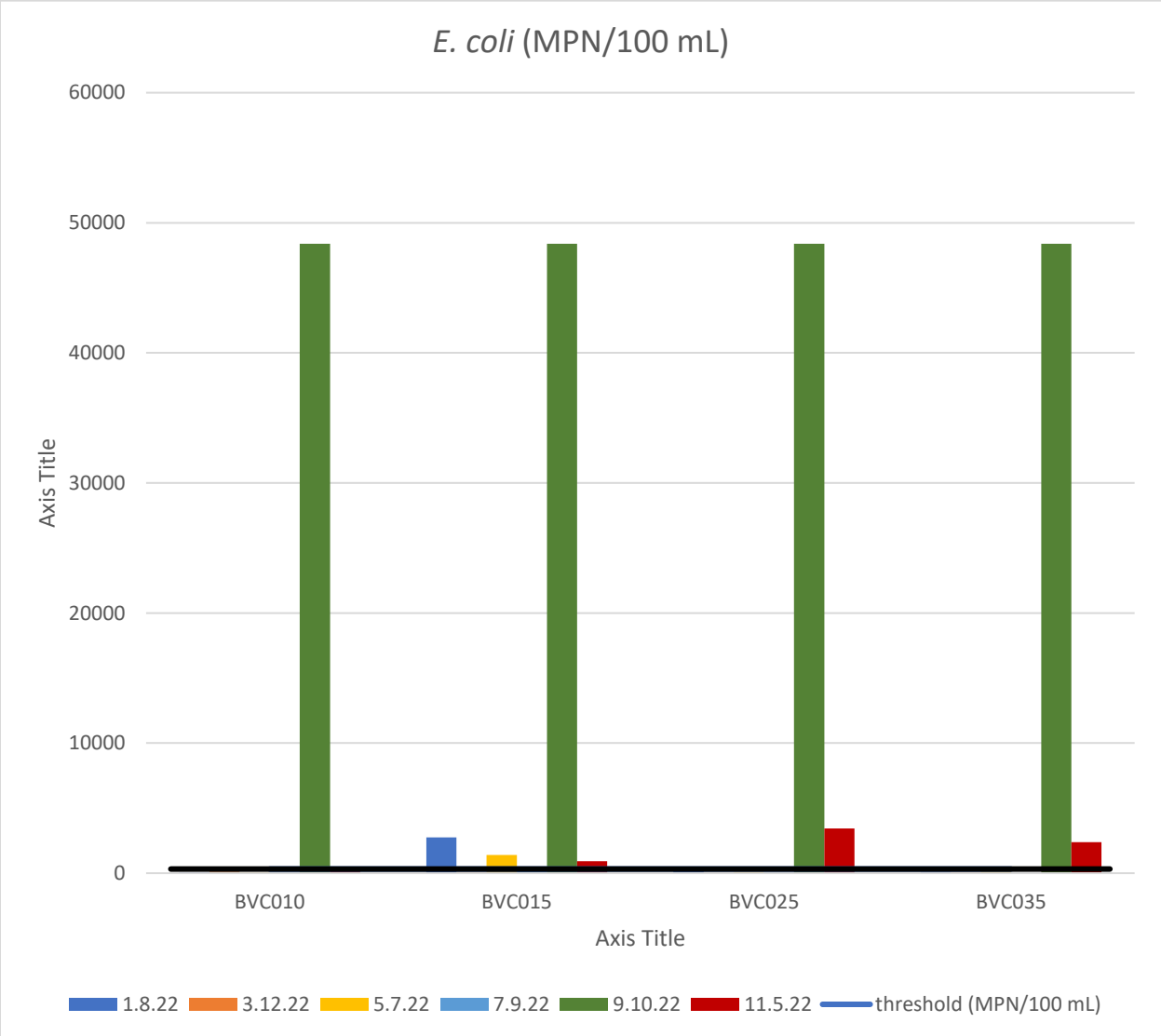
Turbidity (cloudiness), total coliform, *E. coli*, nitrates, total phosphorus, reactive phosphorus and ammonia are measured in the lab using 'grabbed' samples transported from the field. Trained volunteers then process the samples: unfiltered samples are used for total coliform and *E. coli* as well as turbidity and total phosphorus. The remaining filtered sample is used for reactive phosphorus, nitrate, and ammonia. For ammonia testing, because the samples aren't processed within 15' of collection, the pH is lowered to about 2 in the field. pH is titrated back to 6-8 before analysis in the lab. Concentrations are corrected for added volumes of HCl and NaOH.

High turbidity can hinder light penetrating water which may affect photosynthesis. The threshold is 20 FNU. Amongst our sampling sites, BVC010 at the head of the lagoon with little flow consistently was more turbid than our other sites. The rain event in September clearly shows



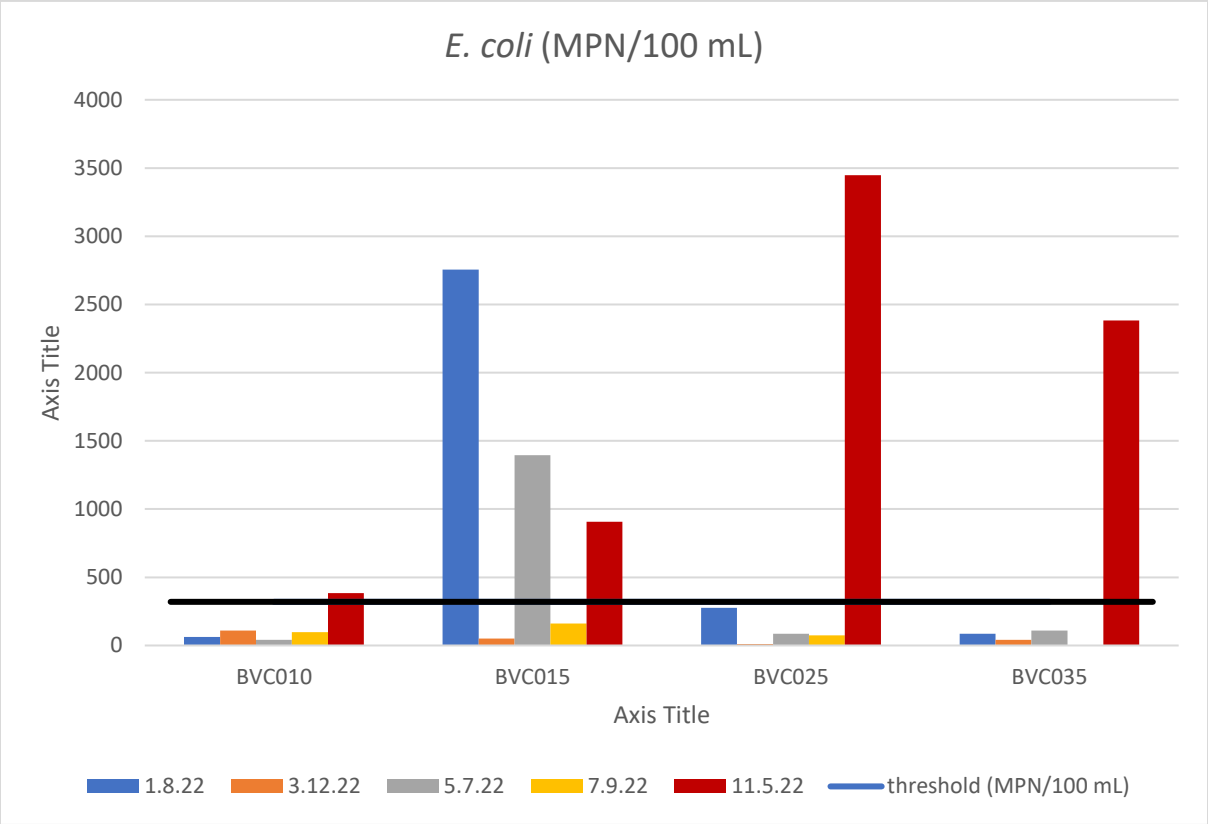
elevated turbidity probably from sediments washing into the watershed. Overall, turbidity readings were higher than 2021, especially for site BVC010.

Coliforms are a group of bacteria found in the digestive tracts of animals, including humans and their wastes. They are also found in plant and soil material. They may or may not indicate pathogenic bacteria. There is no threshold for these bacteria due to the wide types of sources. *E. coli*, however, is much more indicative of potential concern as many strains are pathogenic. The test we run, using IDEXX Quanti-tray/Colilert, measures all *E. coli*, pathogenic or not. The threshold for this bacterium is 320 MPN/100 mL.[3] . The September readings in dark green are an underestimate of the *E. coli* since our dilutions were not great enough to keep the measurements under the measurement upper limit. Whenever there is a 'first flush' of a watershed, higher *E. coli* counts are typical due to accumulated feces over many months being carried into the streams. This particular event far exceeded any *E. coli* counts we've seen in the past. In comparison to 2021, *E. coli* measurements were more likely to be over threshold.

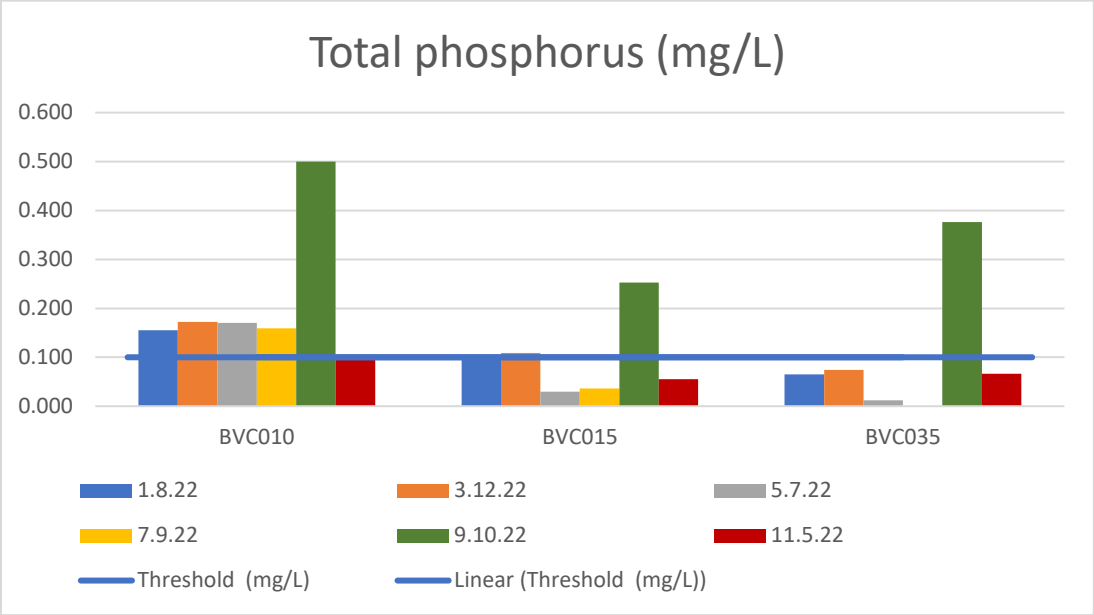


[3]https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/R9_Basin_Plan.pdf and discussion with technical advisor, Chad Loften 4/22/21.

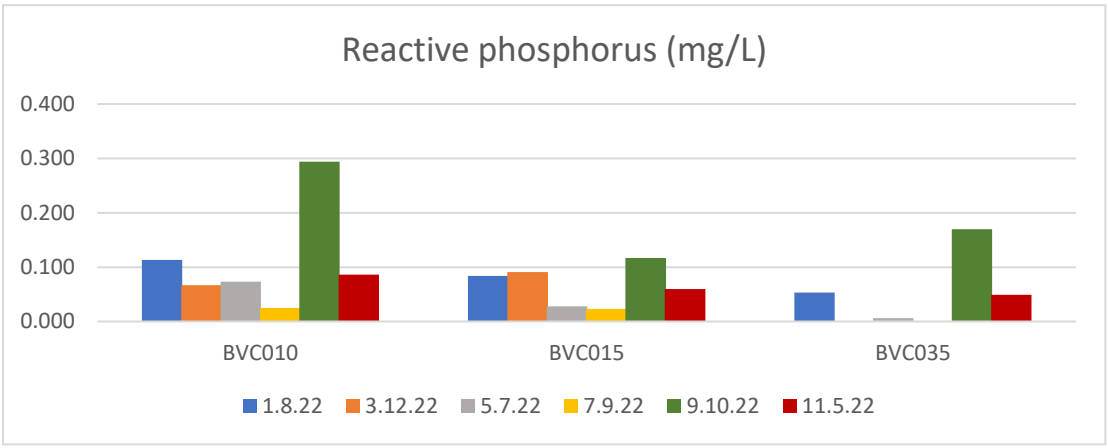
This second graph of *E. coli* has the September data removed to better show the levels during the other sampling sessions which has frequent spikes of *E. coli*. This is not unusual especially at site BVC015.



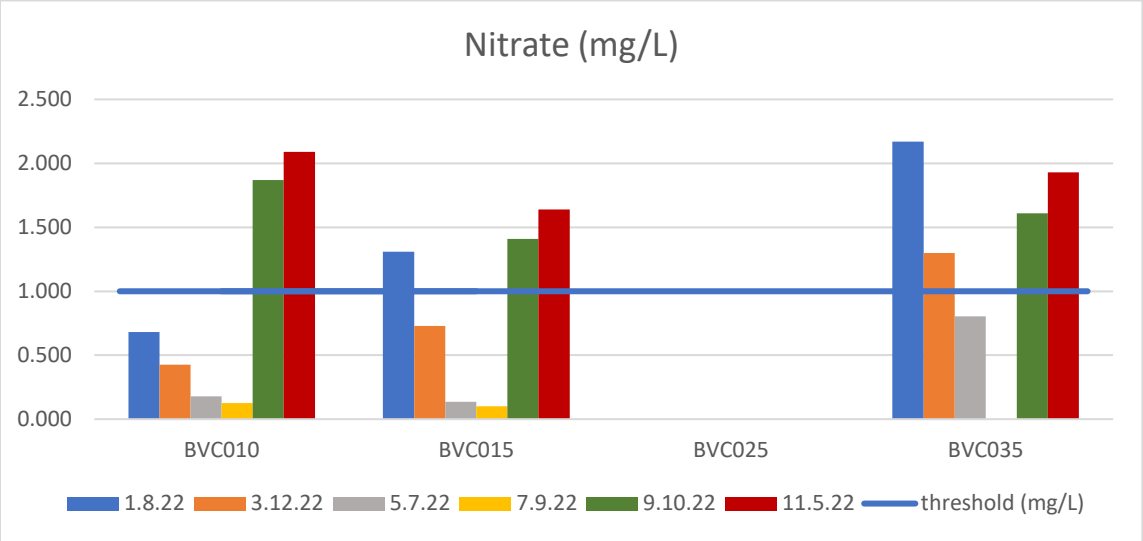
Phosphorus measurements are two-fold. We measure total phosphorus which includes the reactive phosphorus – that compound available to organisms to use. The total phosphorus also includes any other forms of phosphorus which are tied up and not readily available for organisms. BVC010 at the head of the lagoon and with the largest volume of water often is over threshold. The September rain event is evident in the graph. Elevated phosphorus is often the result of fertilizer runoff and can lead to algal blooms. The threshold for San Diego watersheds is 0.1 mg/L[3]. These readings were generally in line with what we saw in 2021.



Reactive phosphorus should be less than the total phosphorus and, except, with one exception (BVC015 in November) this is the case, an improvement over 2021. There is no threshold for reactive phosphorus.



Nitrates, too, generally come from fertilizer runoff. The fall and winter months tended to be higher in nitrates particularly during the rain event in September but also in November. Site BVC035 (most upstream) was consistently higher than the other sites for both this year and in 2021.



Lastly, ammonia[4], whose threshold is 0.025 mg/L was often above (significantly) this level. Natural sources of ammonia come from the breakdown of organic wastes, forest fires, animal from runoff and human waste, exchange with the atmosphere and nitrogen fixation. High ammonia levels can be toxic to wildlife. While variable over time and space, the levels of ammonia are of concern with levels sometimes up to 8 times above threshold. High ammonia levels are more the norm than exception for this watershed. When compared to 2021, the overall profile for each site was similar except for the March spikes not accounted for by a rain event.
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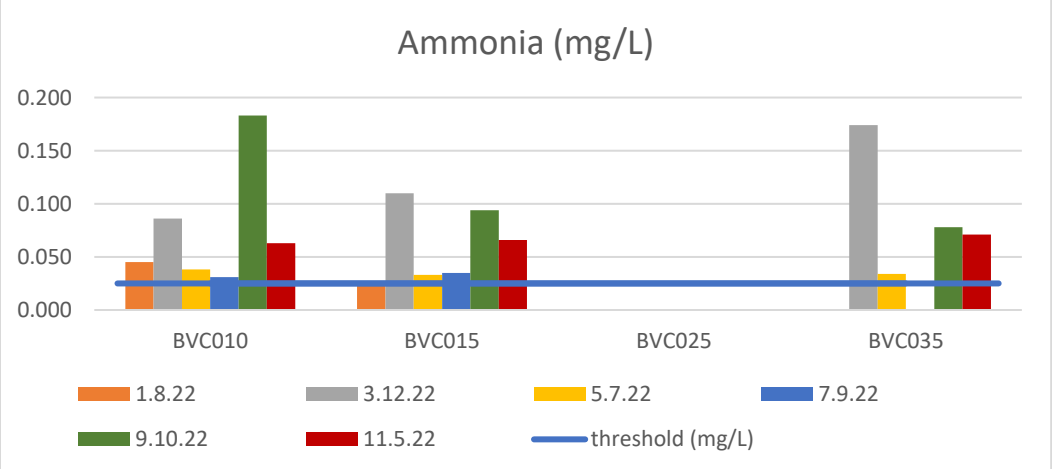
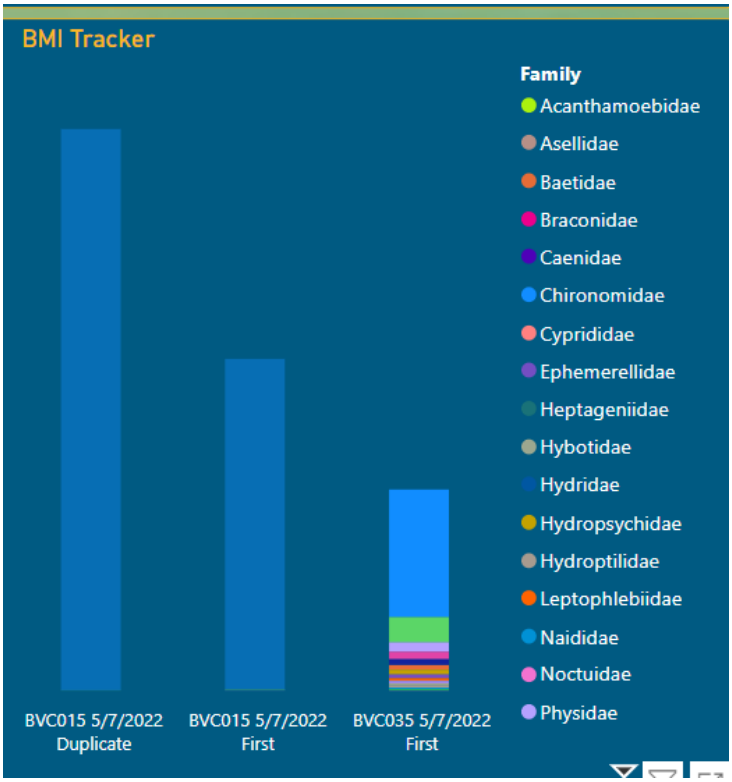


[4]The Hach methodology for measuring ammonia with their TNT830 kit requires the pH be adjusted in the field to ensure accuracy of the results. To the best of our knowledge SDCK did not follow this step nor have we to date. In 2021 pH will be adjusted in the field for the ammonia test procedures. See https://www.hach.com/asset-get.download-en.jsa?id=7639983749 for detailed procedures.

Environmental DNA (eDNA)

This year we partnered with a state program, the SWAMP eDNA Metabarcoding Monitoring and Analysis Project (SeMMAP), to look for species of fish, macroinvertebrates and plankton at selected sampling sites. Samples were filtered in the field and sent to Jonah Labs in Colorado for analysis. For Buena Vista Creek watershed, we took samples at BVC015 and BVC035 in May.

Benthic macroinvertebrates:



At BVC015 only a type of midges were found. However, at BVC035 there were midges, algae, snails, diatoms, flies molds, worms and sow bugs. The type and diversity of these macroinvertebrates is a good indicator that this water is relatively clean.

Fish

Three types of fish were found between the 2 sampling sites – mosquitofish, green sun fish, and fathead minnow. Unfortunately, none of these are native.

Phytoplankton

Site BVC015 had only 2 species of phytoplankton while BVC035 had 15. We don't have anyone knowledgeable about phytoplankton so can't comment on what this means.

Analysis by Site

BVC010, closest to Buena Vista Lagoon and sampled from the edge of the cement sides, had reasonable field measurements (DO, pH, conductivity) except for September where dissolved oxygen (accompanied by dead fish) was extremely low for some unknown reason. *E coli* was only high in September during the rain event where it was high pretty much across the board.. This site tended to be more turbidity than sites upstream and was over threshold twice during the year. Ammonia was routinely high at this site with nitrates high only in the fall. Total phosphorus was at or above threshold throughout the year.

BVC015, near the driving range on Haymar and close to El Camino Real, also exhibited normal field metrics as well as turbidity. There was some improvement in *E. coli* at this site over 2021 but still a large spike in September, along with two other sites at the same time. Two thirds of the sessions had high *E. coli* readings. As with many other sites ammonia was typically high and nitrates frequently above threshold. Total phosphorus in comparison was only high during the September rain event.

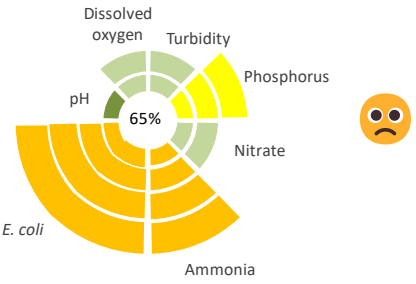
BVC025 was only sampled in for bacteria as a quick grab for lab analysis. It was not atypical being over threshold at the same time (September and November) as most of the other sites. This was similar to 2021.

BVC035 near the Oceanside DMV, was within acceptable range for all field tests. This site frequently has excessive trash and homeless encampments although we haven't seen a good correlation with any of our metrics and said encampments. As with BVC025, *E. coli* spiked in September and November but was otherwise within normal range. Nitrates and ammonia were consistently high here as with the downstream site, BVC025.

Final thoughts

A new addition this year is the development of a scorecard to give a visualization about the overall health of this watershed.

Buena Vista Creek Watershed 2022



Good -> bad ≡ green → red; increasing depth of wedge ⇒ bad

Design from InfoDiagra

The method we developed for our scorecard can be found in Appendix C.

We often can't pinpoint the pollution sources responsible for our data. The NSDCWMP is strictly a monitoring one but one would like to understand these sources. Excessive rainfall certainly contributes to spikes in *E. coli* and total phosphorus. At no time did we see any evidence of potential harmful discharge into Buena Vista Creek.

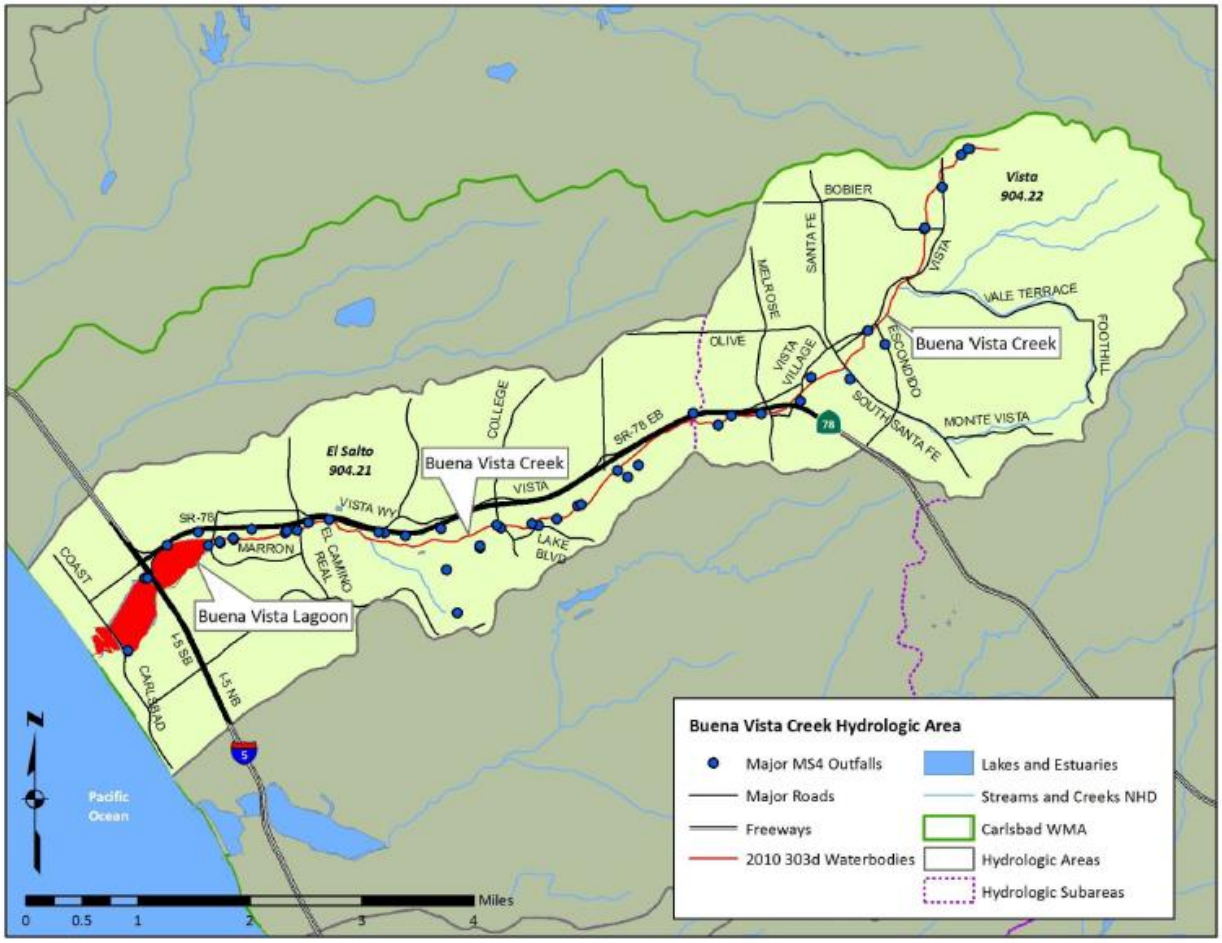
We were dismayed not to find any native fish in our creek but that's not unexpected.

Preserve Calavera will continue to work with SDHC and CNLM as well as city stormwater managers to alert them of metrics of concern, especially *E. coli.* We have expanded our cleanup and monitoring efforts at/near El Salto Falls (BVC025) in conjunction with SDHC and hope to receive funding for more monitoring in the near future. The area around El Salto Falls continues to be a major area of concern for the city of Oceanside, SDHC and ourselves due to heavy encampments and trash.

In closing, note that we began to collect samples in Sept., 2022 for microfiber analysis (a subset of microplastics) but are still in the process of analyzing those results.

APPENDIX A

Figure A-2: Buena Vista Creek HA – Major Outfall Information



From WQIP (2018) of Carlsbad Watershed Area, Appendix A, MS4 Outfalls.

APPENDIX B – Sample site photos

BVC010

Under Jefferson St bridge looking north from opposite side of collection site.

Site in September with extremely low dissolved oxygen.

BVC015 – near Haymar driving range. Very typical photo.

BVC025 – Under El Salto Falls Rd bridge

BVC035 – On Thunder Dr, near Oceanside DMV

APPENDIX C

Scorecard parameters:

Metric (threshold)	5	4	3	2	1	0
DO (5.0)	>9.0	7.01-8.99	5.0-7.0	4.0-5.0	3.0-4.0	<3.0
pH (6.5-8.5)	6.5-8.5	6.3-6.49,8.5-8.7	6.1-6.29,8.71-8.9	5.9-6.09,8.91-9.10	5.7-5.89,9.1-9.5	<5.5 or >9.5
turbidity (20)	<5	5.1-20.0	20.1-30.0	30.1-40	40.1-60	>60.1
Nitrates (1.0)	0.5	.61-1.0	1.01-1.50	1.51-2.00	2.01-3.00	>3.01
Ammonia (.025)	<0.0125	.0125-.025	0.026-.0375	0.0376-.050	0.0501-.075	>.0751
E. coli (320)	<160	160-320	321-480	481-640	641-960	>961

Blue indicates separate ranking than in table 1

Assigned weight	Range relative to threshold
5	<50%
4	50-100%
2	151-200%
1	201-300%
0	>301%

E. coli was counted twice on the 'wheel' due to its pathogenic nature. All other parameters with thresholds within the San Diego Basin were counted once giving a total of 8 wedges in the wheel. The numbers (0-5) were added and compared to a perfect score of 40. We gave an overall score based upon the following ranking:

RANKINGS

- Excellent >90% 😀
- Good 80-89.5% 🙂
- Fair 70-79.5% 😑
- Poor 60-69.5% 😟
- Terrible <60% 😱