

DEEP CREEK LAKE
CONTINUOUS WATER
QUALITY MONITORING
PROGRAM
2021

Cherry Creek Cove
Red Run Cove
Green Glade Cove

Slide 1

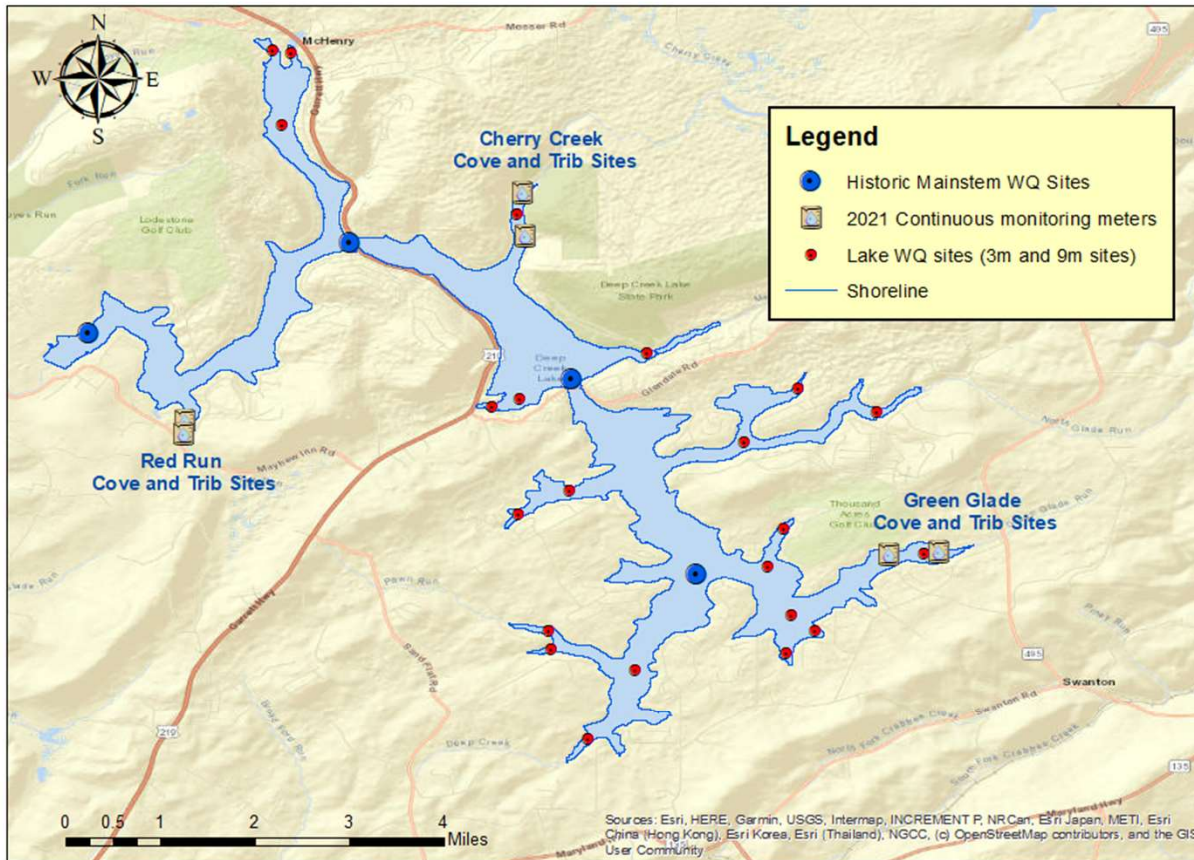
- 1 If this is being presented as a power point presentation, versus a hand-in report, the bulleted points in the slides will need to be shortened to hold the attention of the audience and improve readability/visibility of the graphics and text. Consider using the Speaker Notes section for additional details.

Megan M McGinn-Meals -DNR-, 4/27/2022

- 1 Just confirmed - it is a hand in presentation and NOT a power point presentation.

Lisa Eutsler -DNR-, 4/27/2022

2021 Continuous Monitoring Meters Sites

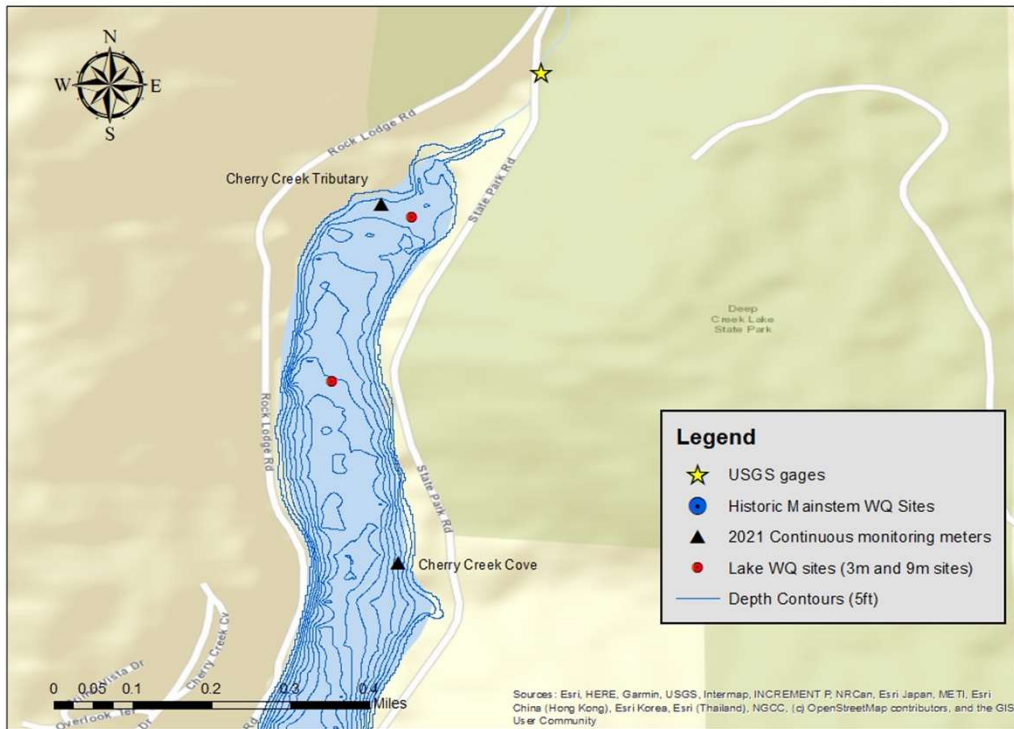


- In 2021, six continuous monitors (meters) were deployed around Deep Creek Lake in fixed locations from May through September. Two meters were paired in each cove. The three coves were: Cherry Creek Cove, Red Run Cove and Green Glade Cove.
- The locations within the coves were chosen based on their proximity to the tributary (Trib location) or their location within the cove that provided the best level of exposure to activity such as wind and waves (Cove location), as well as permission from the dock owners.
- The meters were secured to a dock or placed in a modified crab pot and placed under a dock in order to ensure protection of the meter.
- The meters were programmed to take readings every 15 minutes. The parameters included: Temperature, dissolved oxygen, pH, turbidity, specific conductance, chlorophyll, and phycocyanin (blue-green algae).
- Every three weeks, the meters were rotated allowing time for the original meter to be cleaned, serviced and recalibrated. This process ensured the most accurate data possible, without interrupting the continuous collection of data.

Cherry Creek Cove 2021

Continuous Monitoring Meter Locations

2021 Water Quality Monitoring Locations
Discrete and Continuous Monitoring

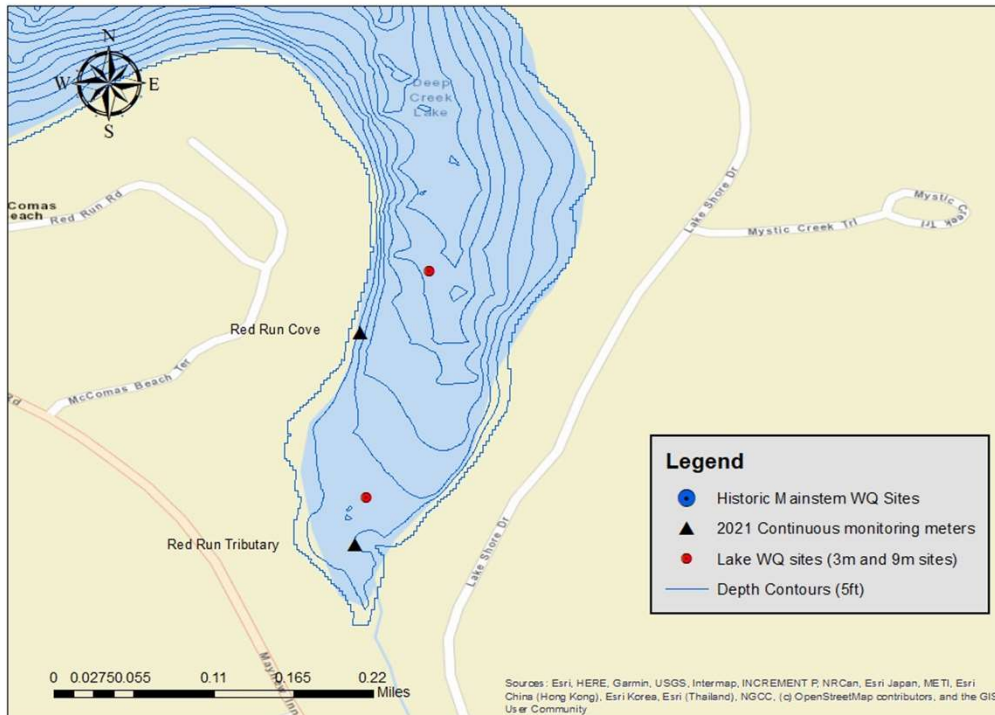


- ❑ Two continuous monitoring meters were placed in Cherry Creek Cove. The two stations were approximately 700 meters apart.
- ❑ Cherry Creek Cove location: 2710 State Park Road;
Coordinates: 39.5290, -79.3184
- ❑ Cherry Creek Trib location: 2354 Rock Lodge Road;
Coordinates: 39.5356, -79.3183
- ❑ Cherry Creek Cove site was placed on a dock near the center of the cove to get a better understanding of how the input from Cherry Creek affects the cove's water quality overall, as well as monitor effects from wind, wave action and runoff. Depth at this station ranged from 2.8 – 2.1 meters throughout the monitoring season.
- ❑ Cherry Creek Trib site was placed on a dock near the mouth of Cherry Creek to monitor input from the creek, as well as monitor the shallow areas of the cove. Depth at this station ranged from 1.75 – 1.4 meters throughout the monitoring season.

Red Run Cove 2021

Continuous Monitoring Meter Locations

2021 Water Quality Monitoring Locations
Discrete and Continuous Monitoring

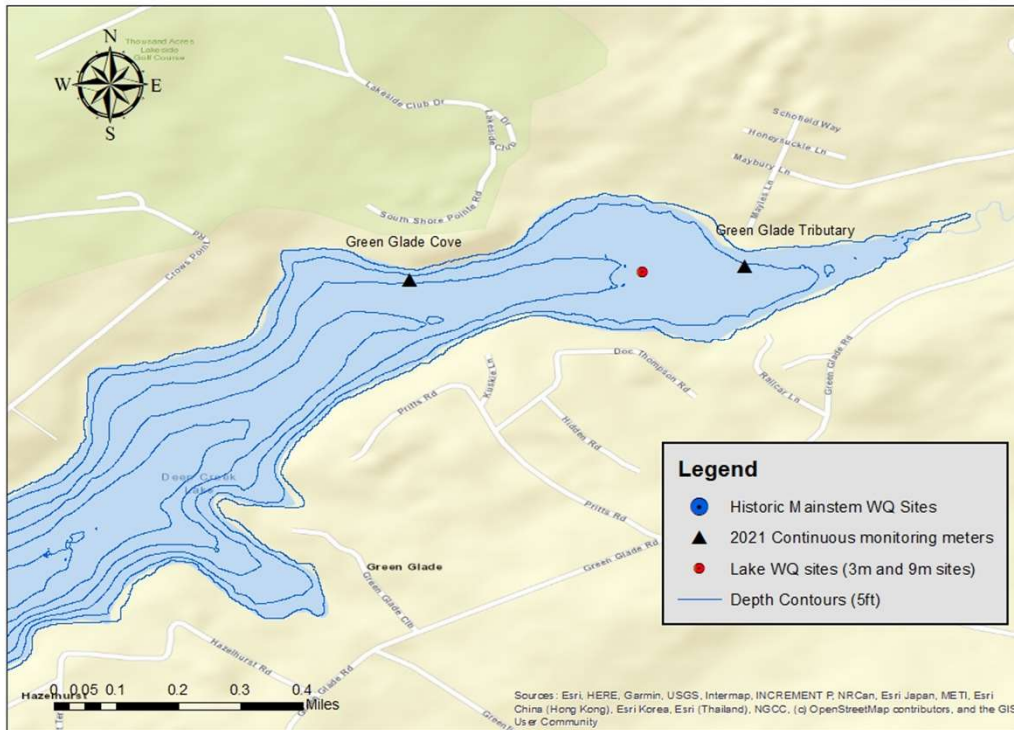


- ❑ Two continuous monitoring meters were placed in Red Run Cove. The two stations were approximately 235 meters apart.
- ❑ Red Run Cove location: 138 McCombs Beach Terrace;
Coordinates: 39.5006, -79.3705
- ❑ Red Run Trib location: 411 Lake Shore Drive;
Coordinates: 39.4985, -79.3703
- ❑ Red Run Cove site was placed on a dock near the center of the cove to get a better understanding of how the input from Red Run affects the cove's water quality overall, as well as monitor effects from wind, wave action and runoff. Depth at this station ranged from 2.5 – 1.4 meters throughout the monitoring season.
- ❑ Red Run Trib site was placed on a dock near the mouth of Red Run to monitor input from the creek, as well as monitor the shallow areas of the cove. Depth at this station ranged from 2.0 – 1.0 meters throughout the monitoring season.

Green Glade Cove 2021

Continuous Monitoring meter locations

2021 Water Quality Monitoring Locations
Discrete and Continuous Monitoring



- ❑ Two continuous monitoring meters were placed in Green Glade Cove. The two stations were approximately 675 meters apart.
- ❑ Green Glade Cove location: 245 South Shore Pointe Road; Coordinates: 39.4800, -79.2626
- ❑ Green Glade Trib location: Mayles Ln, Mayberry Poling Common Dock; Coordinates: 39.4804, -79.2549
- ❑ Green Glade Cove site was placed on a dock near the center of the cove to get a better understanding of how the input from Cherry Creek affects the coves water quality overall, as well as monitor effects from wind, wave action and runoff. Depth at this station ranged from 2.5 – 2.0 throughout the monitoring season.
- ❑ Green Glade Trib site was placed on a dock near the mouth of Green Glade to monitor input from the creek, as well as monitor the shallow areas of the cove. Depth at this station ranged from 2.0 – 1.0 throughout the monitoring season.

Temperature

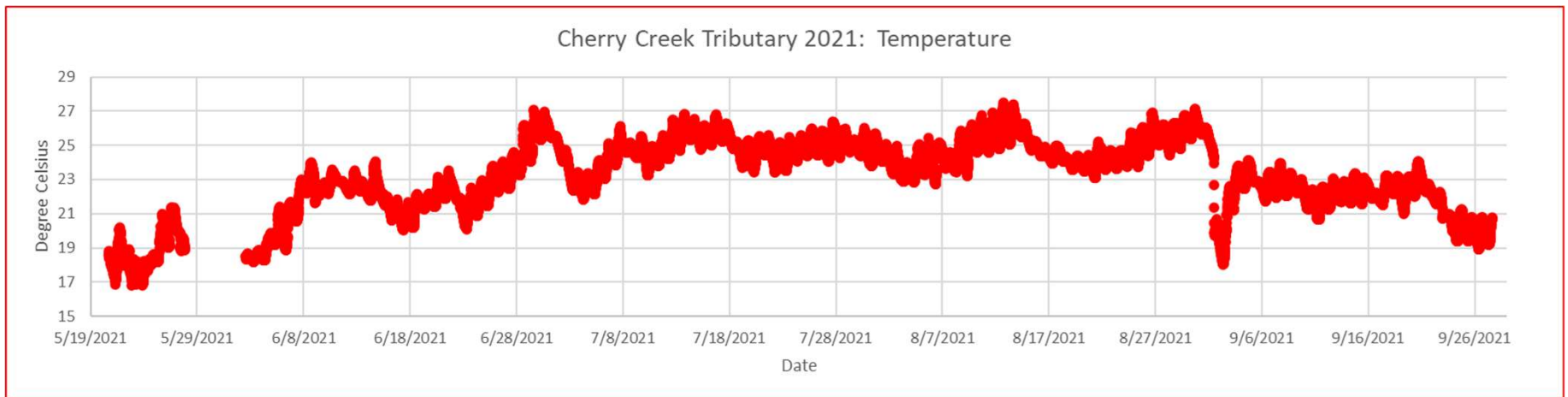
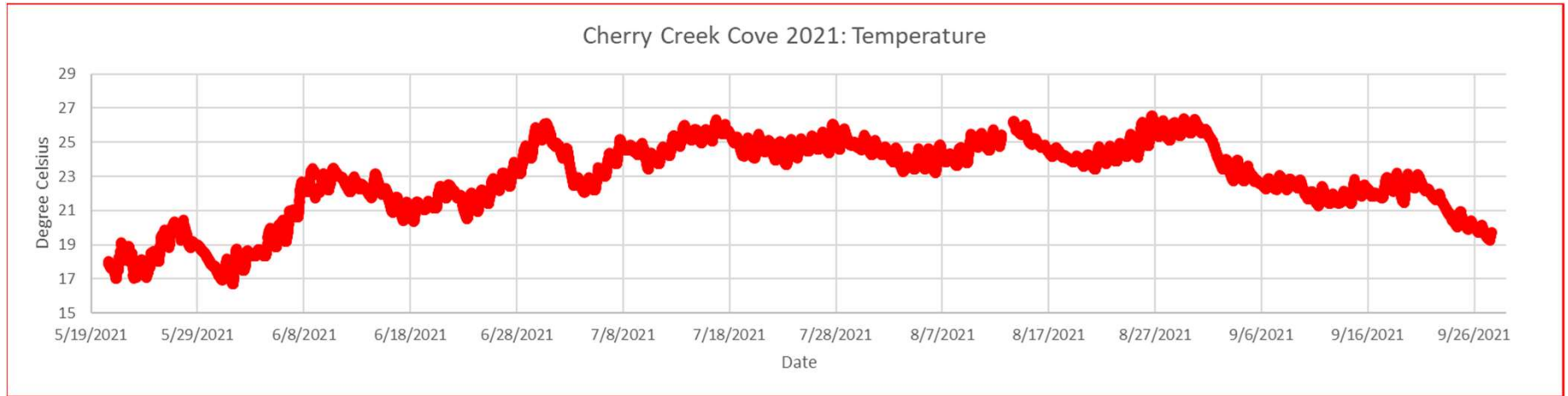
Temperature: Measures the temperature of the water in degrees Celsius. Temperature affects both the biological and chemical characteristics of surface water. Some parameters we are measuring that are affected by a change in temperature include dissolved oxygen, pH, chlorophyll and specific conductance. The lower the temperature of the water, the more dissolved oxygen (DO) it can hold, so as the temperature of the water increases, DO will decrease. pH and chlorophyll tend to decrease with increased temperature, as well. However, specific conductivity may increase with higher temperatures. This is due to warmer water being able to dissolve more minerals from the surrounding rock and sediments, this effect is dependent upon the type of rock and sediments in the area. (see 1 and 2 on the citations slide)

Preferred temperature range for aquatic life is 5 - 25 degrees Celsius. The long-term average (May – September 2009 – 2021) for Deep Creek Lake surface temperature is 20.92 degrees Celsius.

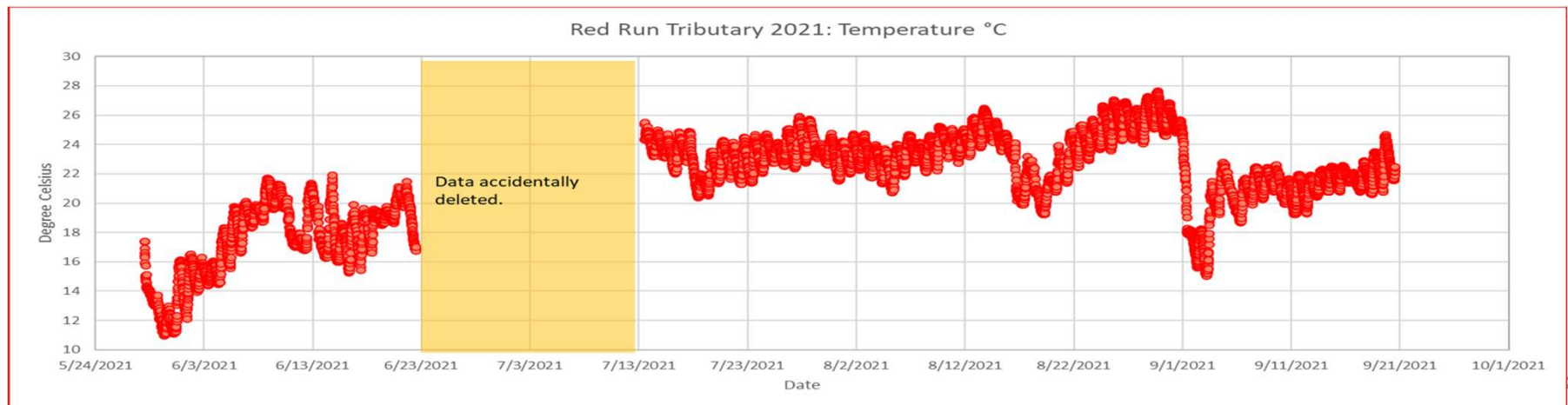
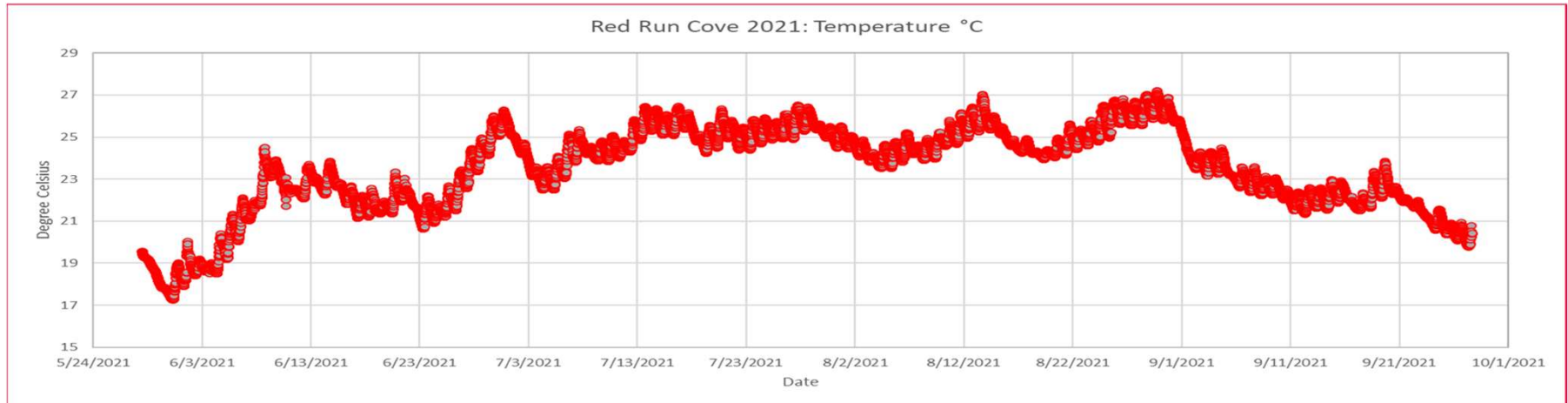
Temperature ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	17.6 – 27.7	22.5
Cherry Creek Cove site	16.7 – 26.6	22.9
Cherry Creek Trib site	16.6 – 27.5	23.0
Red Run Cove site	17.2 – 27.2	23.5
Red Run Trib site	10.9 – 27.6	21.4
Green Glade Cove site	13.2 – 28.3	23.2
Green Glade Trib site	13.1 – 30.3	23.1

Please note that each graph below has its own range in order to get the best view of the data.

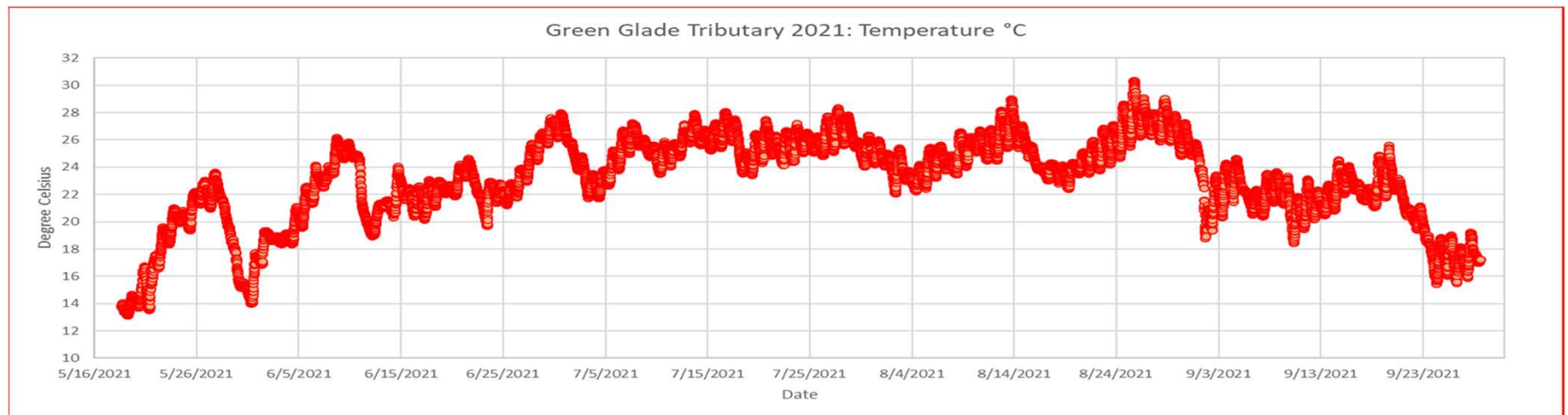
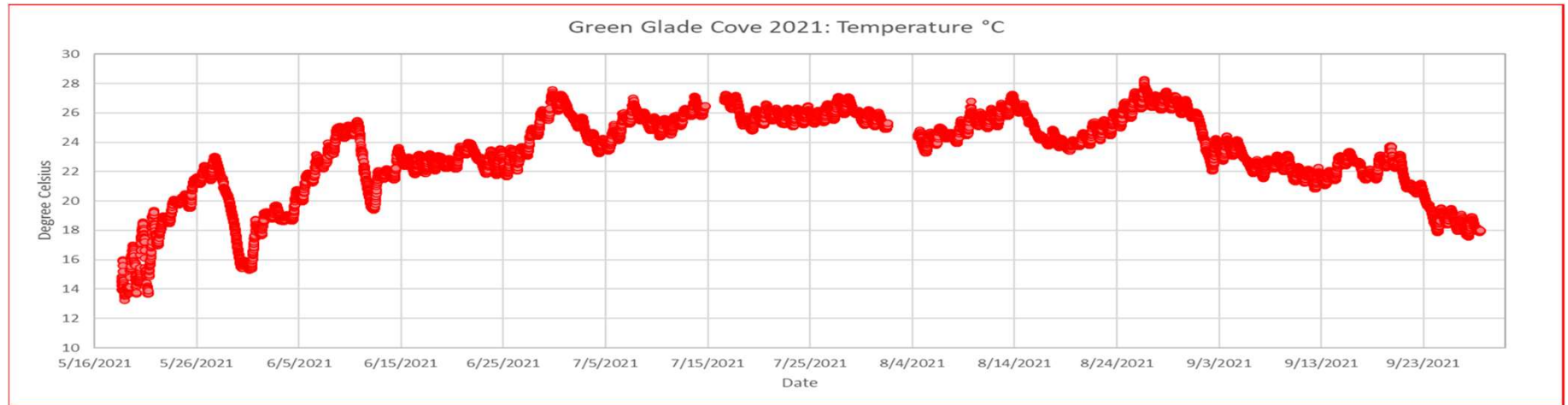
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27/20, 2021



Green Glade Cove May 20 – September 27, 2021



pH

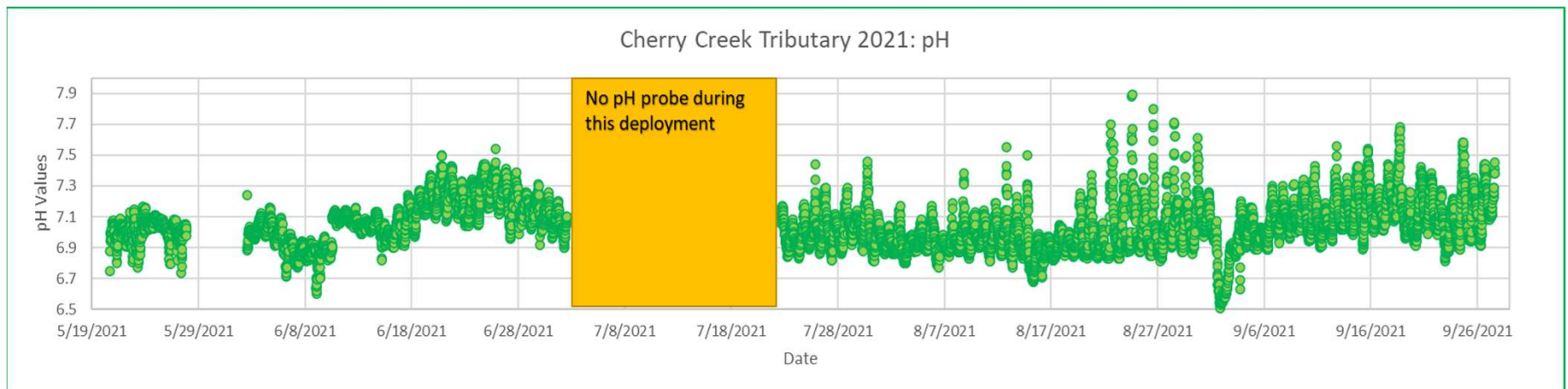
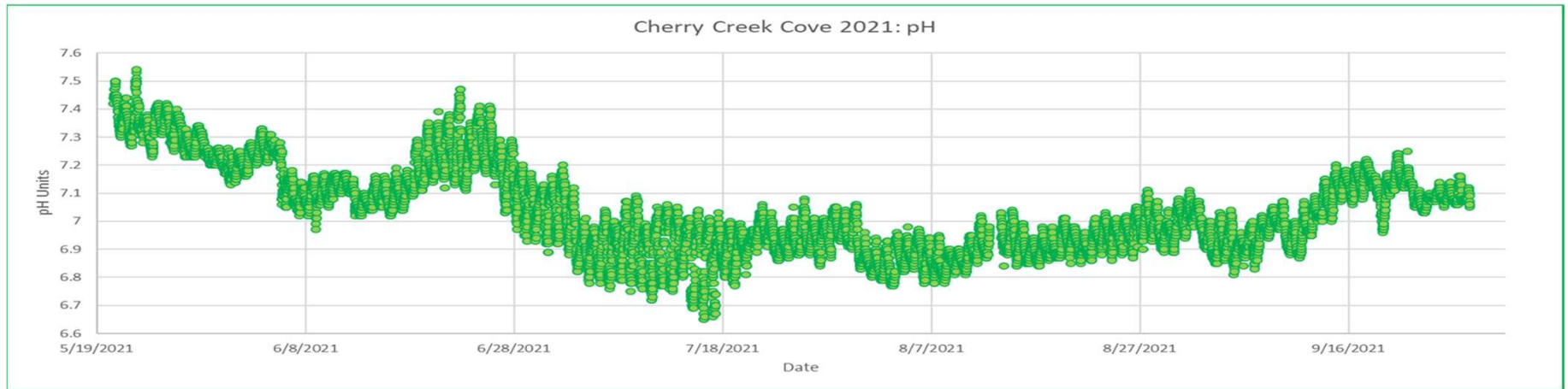
pH: pH is a chemical measure of whether something is an acid or a base. It is measured on a log scale of 0 to 14. Lower pH (acid) is sometimes seen in fresh waters due to acid precipitation or even naturally-occurring organic acids, which can be found in areas with wetlands. High pH (base) can occur during algae blooms due to chemical processes associated with photosynthesis. Most aquatic life prefers a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range. During photosynthesis, aquatic plants remove carbon dioxide from the water. This can raise the pH in the water. Since plants photosynthesize with sunlight, the pH of the water will be highest during the middle of the afternoon, and lowest just before sunrise. The continuous monitoring data will show diurnal variations representing this photosynthetic process. (see 3, 4, and 5 on the citations slide)

The preferred pH range for aquatic life is between 6.5 - 9. The long-term average (May – September 2009 – 2021) for Deep Creek Lake surface pH is 7.17

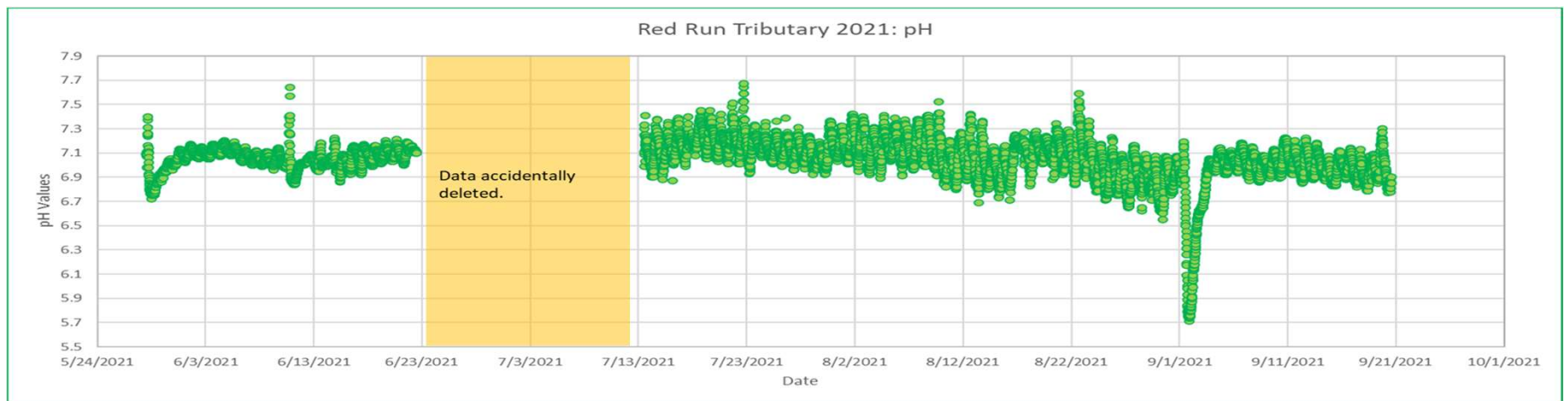
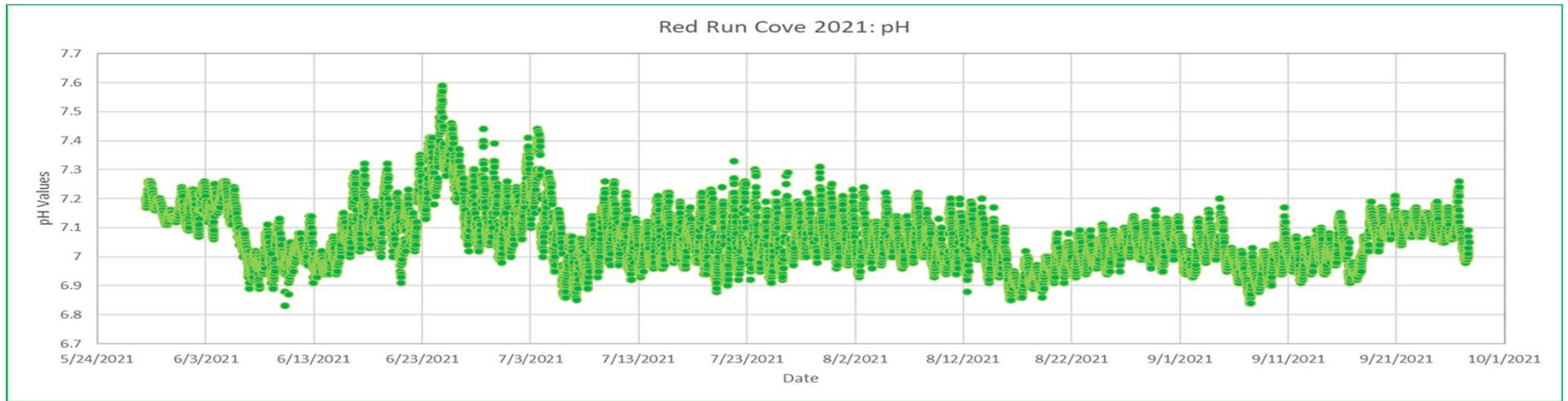
pH ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	6.6 – 8.3	7.09
Cherry Creek Cove site	6.7 – 7.5	7.00
Cherry Creek Trib site	6.5 – 7.9	7.04
Red Run Cove site	6.8 – 7.6	7.10
Red Run Trib site	5.7 – 7.7	7.05
Green Glade Cove site	6.7 – 8.8	7.17
Green Glade Trib site	5.9 – 9.4	7.30

Please note that each graph has its own range in order to get the best view of the data.

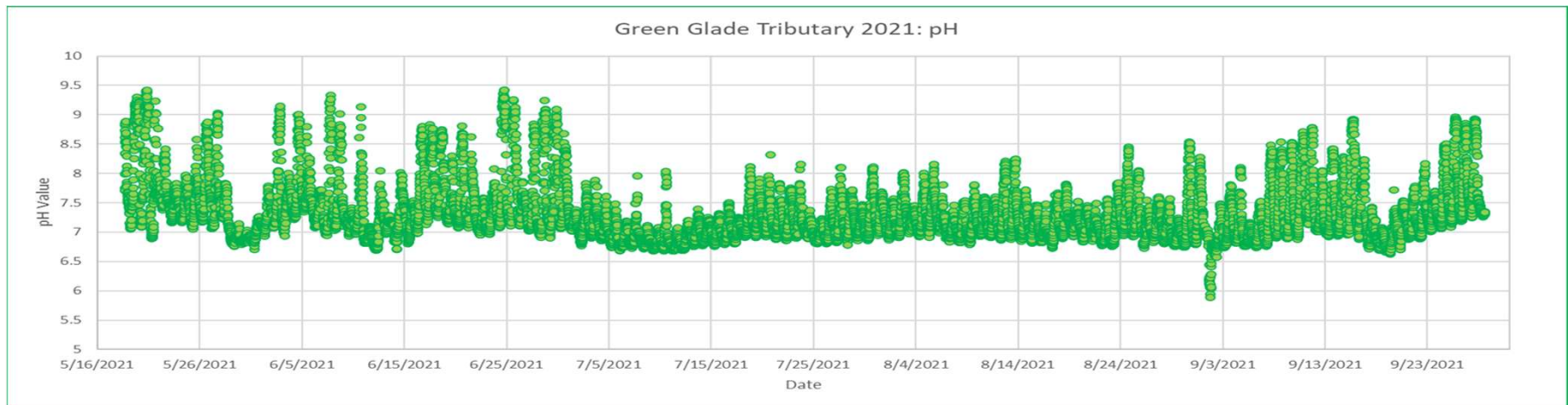
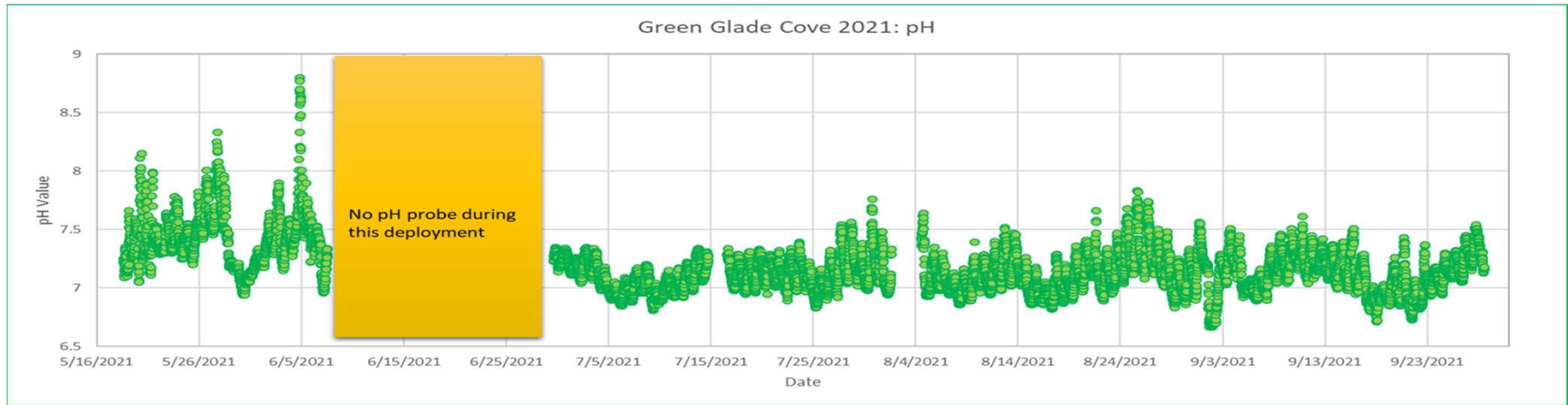
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27 / 20, 2021



Green Glade Cove May 18 – September 28, 2021



Specific Conductance

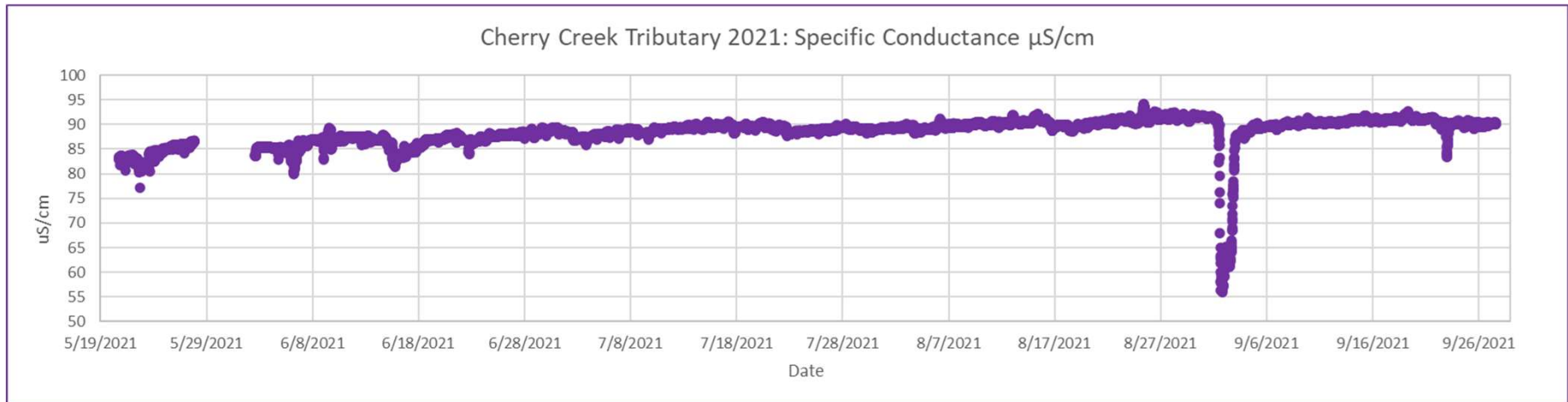
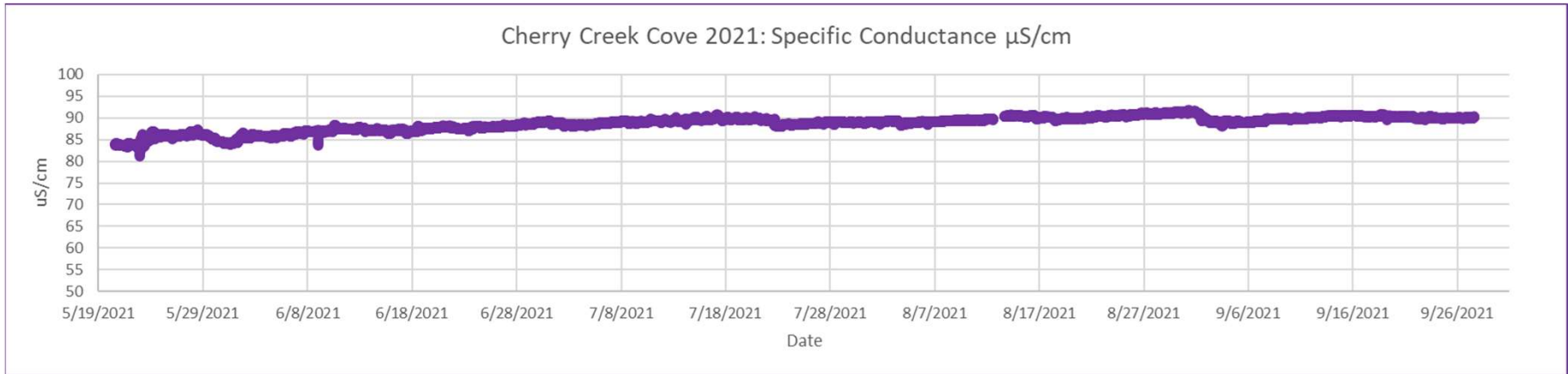
Specific Conductance: This is a measure of how well electricity can flow through water -a water-quality property whose value is proportional to the collective concentration of ions in solution. The specific conductance measurement depends on the concentration of ions, which come from various salts and inorganic materials in the water, and the temperature of the solution. You will notice an increase or decrease (dependent on what type of rock or minerals are present in the tributary) during high flow events. This especially noticeable in our meters that are placed closest to the tributaries. (see 2, 3 and 6 on the citations slide)

The conductivity of fresh water in the United States generally ranges from 50 to 1500 $\mu\text{S}/\text{cm}$. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 $\mu\text{S}/\text{cm}$. The long-term average for Deep Creek Lake surface specific conductance is 92.3 $\mu\text{S}/\text{cm}$.

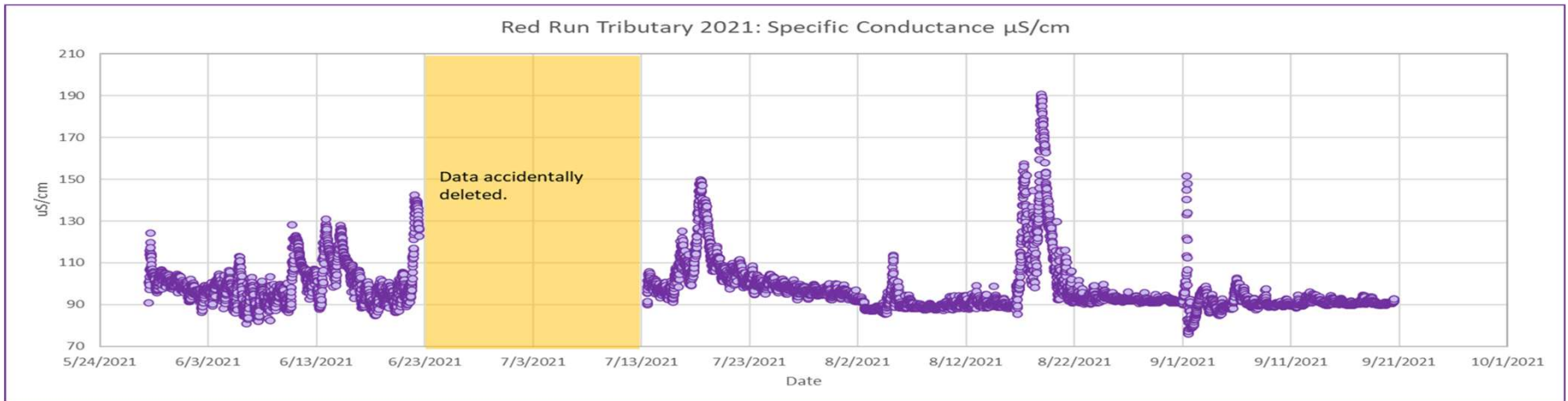
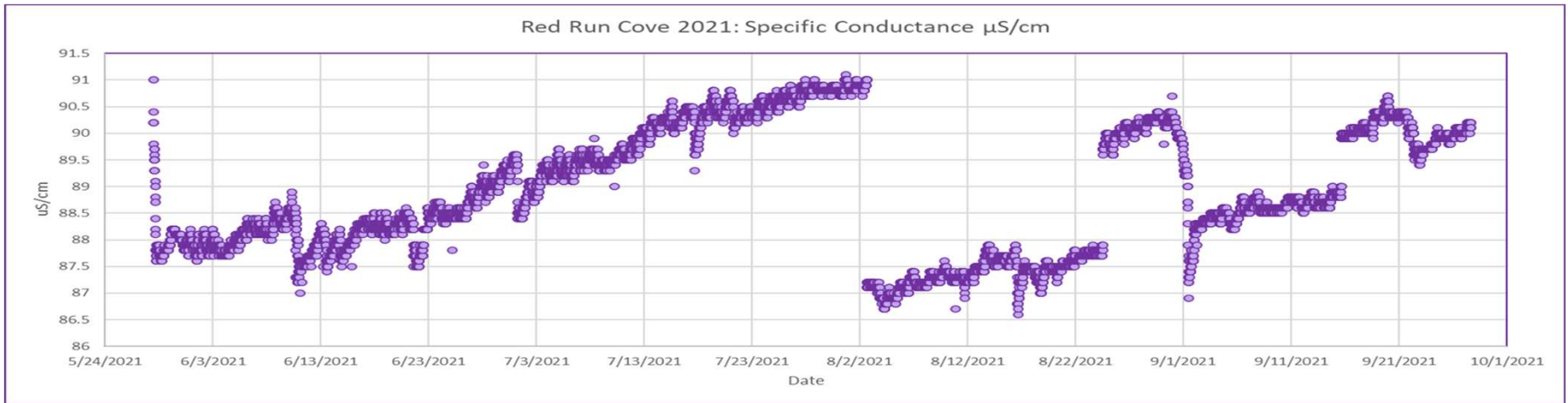
Specific Conductance ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	84 - 109	88.9
Cherry Creek Cove site	81.1 – 91.9	88.7
Cherry Creek Trib site	55.9 – 94.1	88.5
Red Run Cove site	86.6 – 91.1	88.9
Red Run Trib site	75.9 – 190.7	97.5
Green Glade Cove site	80 – 89.9	85.8
Green Glade Trib site	77.1 – 105.2	86.3

Please note that each graph has its own range in order to get the best view of the data.

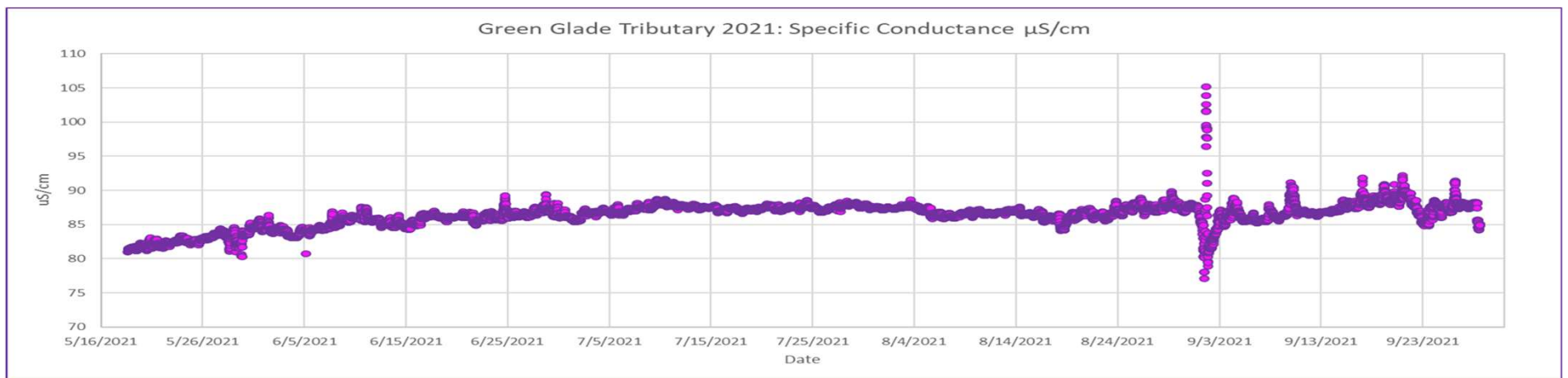
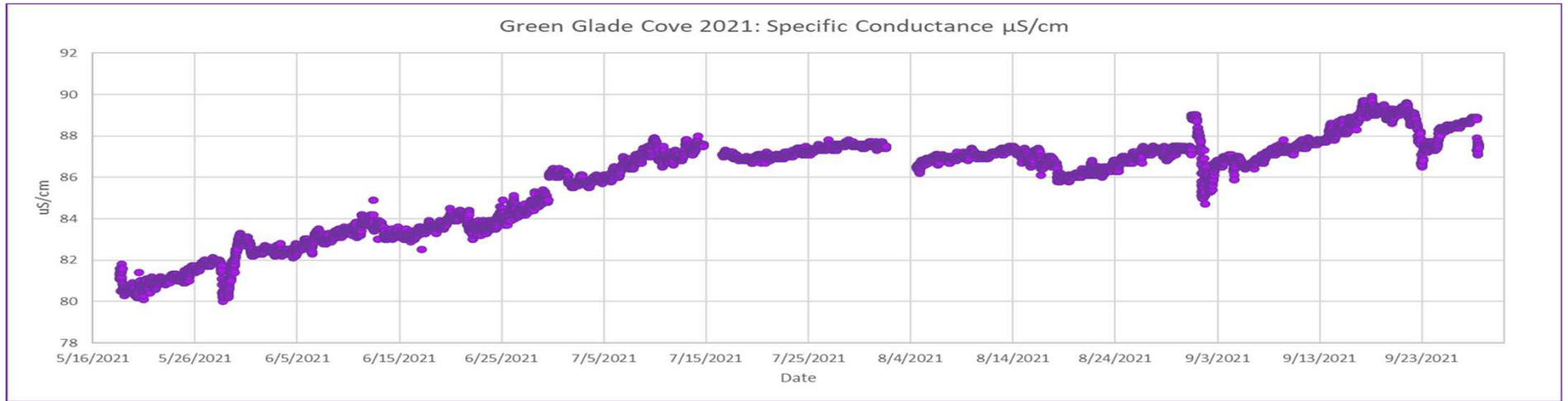
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27 / 20, 2021



Green Glade Cove May 18 – September 28, 2021



Turbidity

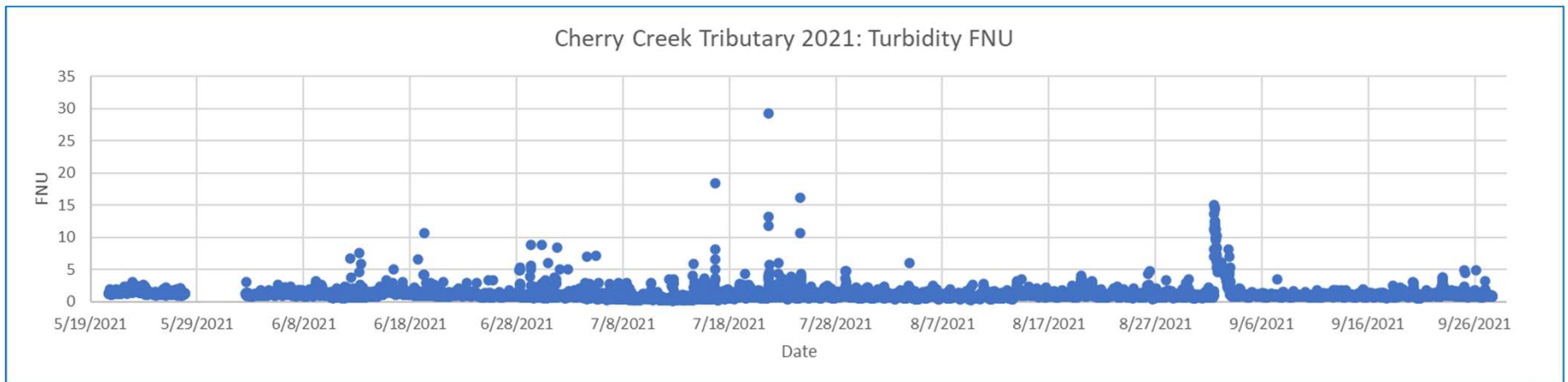
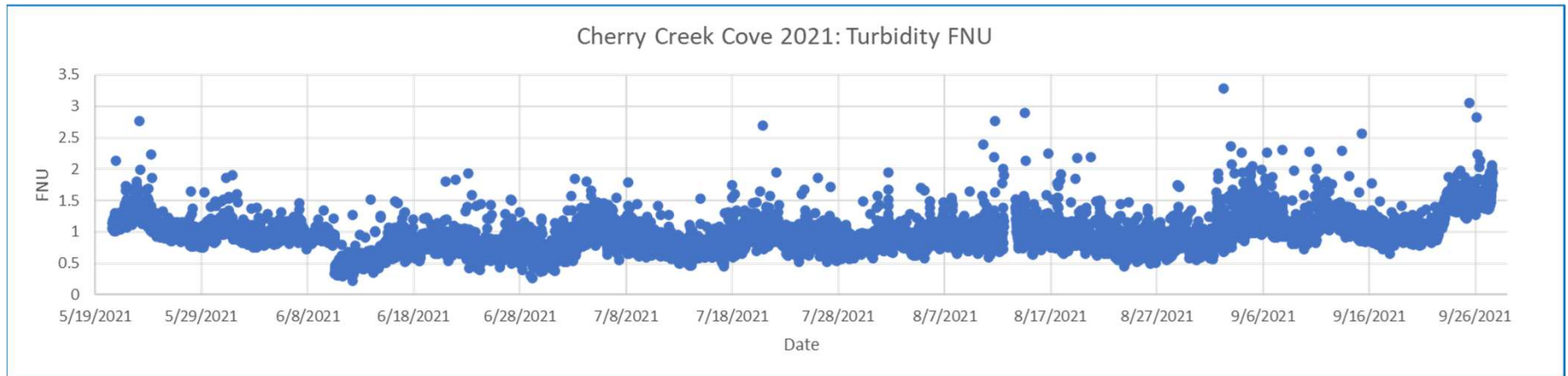
Turbidity: Turbidity is a measure of the clarity of water. Turbid waters typically appear cloudy and have high concentrations of total suspended solids (TSS), thereby allowing less light to penetrate through the water. Increased turbidity can be due to excessive algal growth, land runoff and shoreline erosion, pollution, resuspension of bottom sediments, dredging operations, or during high periods of fresh-water input from tributaries. Continuous turbidity values over a threshold of 15 NTUs (Nephelometric Turbidity Units) or FNU (Formazin Nephelometric Units) are normally considered to be detrimental to submerged aquatic vegetation growth and overall ecological productivity. Increased turbidity can also lead to decreased fish health by increasing susceptibility to infectious diseases through increased stress and reducing the ability of fish's gills to extract dissolved oxygen from the water, as well as decrease the recreational value of a water body. (see 2 and 3 on the citations slide)

The preferred turbidity range for aquatic life is below 15 FNU. The long-term average (May – September 2009 – 2021) for Deep Creek Lake surface turbidity is 1.96 FNU.

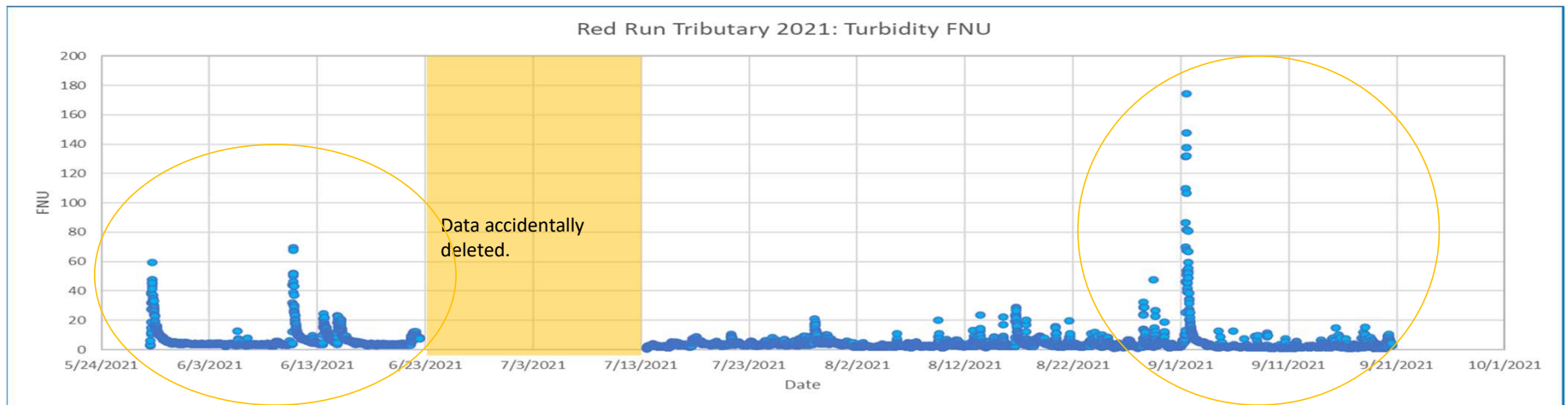
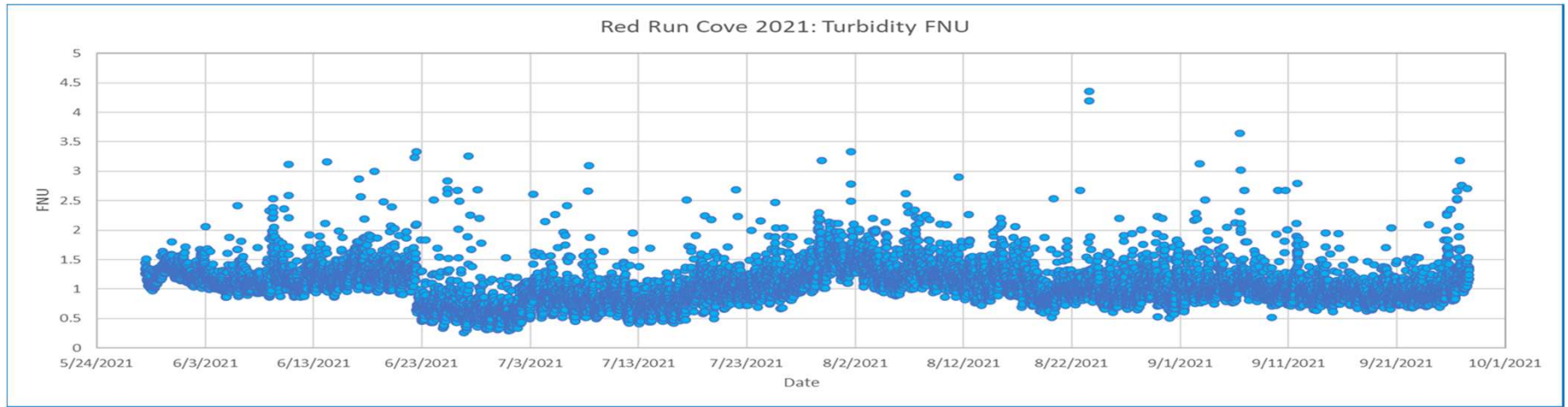
Turbidity ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	0.9 – 17.50	2.66
Cherry Creek Cove site	0.22 – 3.29	0.93
Cherry Creek Trib site	0.08 – 29.30	1.08
Red Run Cove site	0.26 – 4.36	1.07
Red Run Trib site	0.51 – 174.15	4.35
Green Glade Cove site	0.34 – 14.95	3.44
Green Glade Trib site	1.49 – 58.74	6.50

Please note that each graph has its own range in order to get the best view of the data.

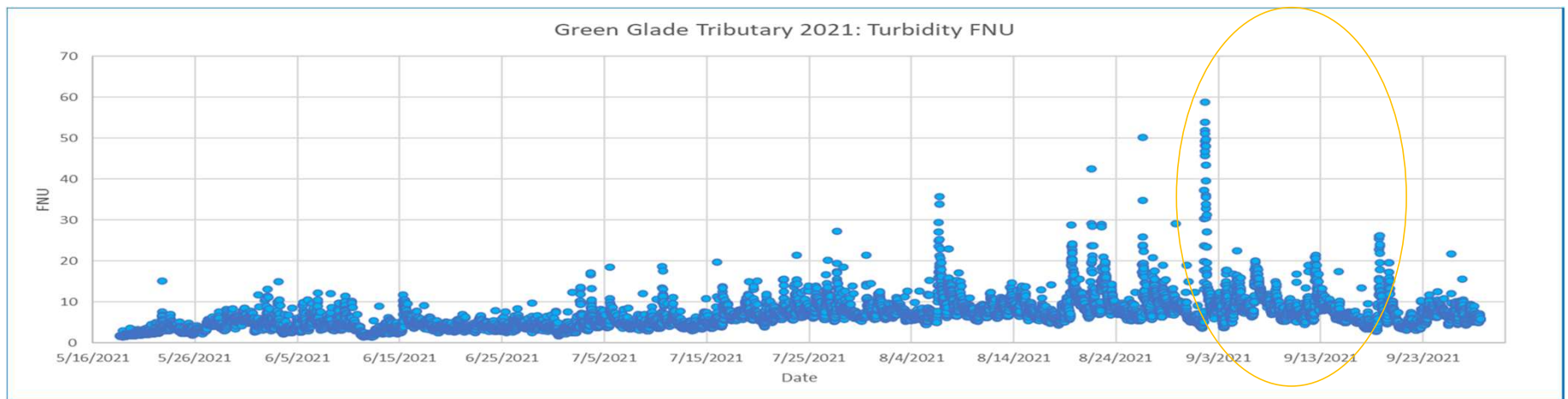
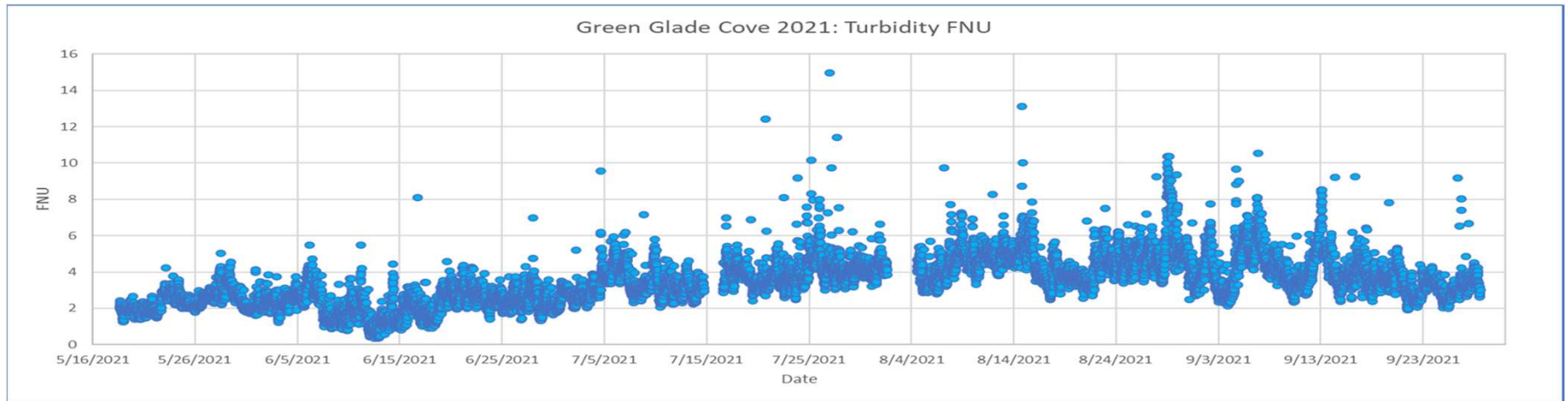
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27 / 20, 2021



Green Glade Cove May 18 – September 28, 2021



Dissolved Oxygen

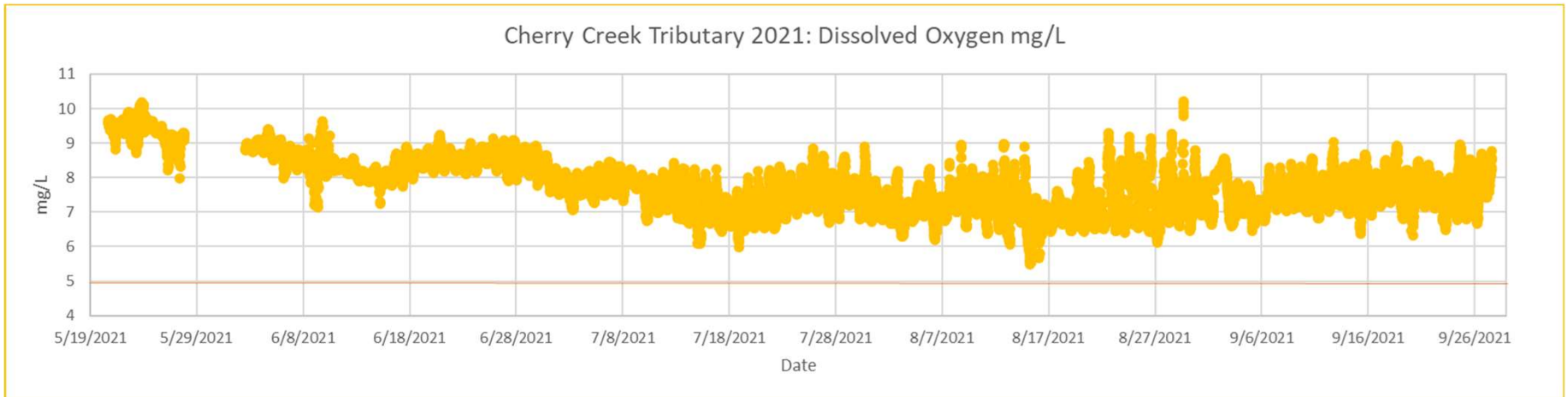
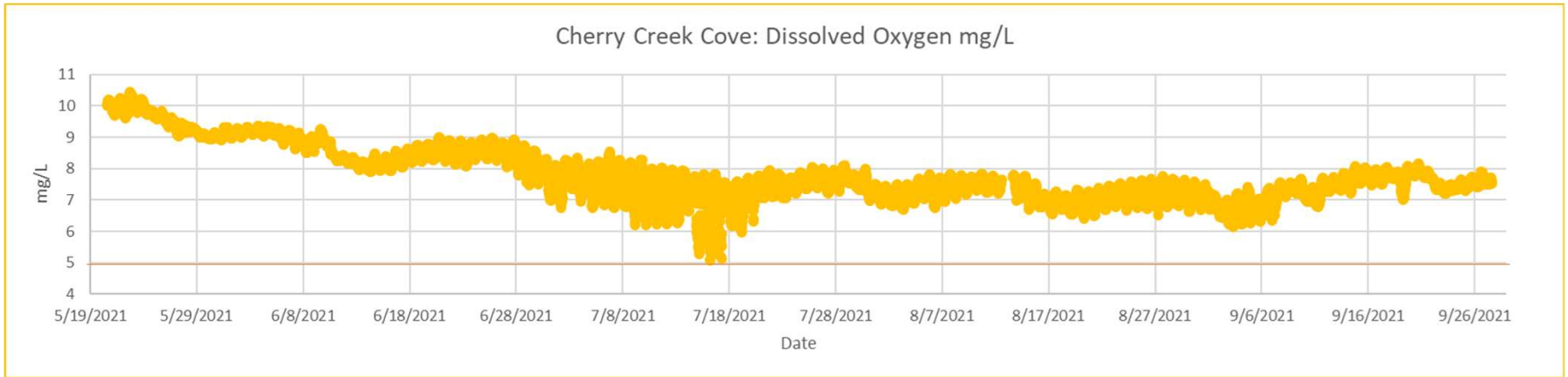
Dissolved Oxygen (DO): Dissolved oxygen measures the amount oxygen molecules which have dissolved in water. DO is measured as a concentration (mg/l – milligrams per liter). When DO concentrations drop below 5 mg/l, more sensitive organisms, such as fish, become stressed, especially if exposed to these conditions for prolonged periods. The concentrations of DO are affected by several factors. Temperature affects the concentration since warmer water cannot dissolve as much oxygen as colder water. Also, in most cases, the DO graphs from the continuous monitoring stations show daily variations, with peaks in late afternoon and minimums at dawn. These peaks are due to the production of oxygen by algae and submerged aquatic vegetation during the daytime and the consumption of oxygen at night by algae and other organisms in the water and bottom sediments. (see 2 and 3 on the citations slide)

The preferred dissolved oxygen range for aquatic life is above 5mg/L. The long-term average (May – September 2009 – 2021) for Deep Creek Lake surface dissolved oxygen is 8.25 mg/L.

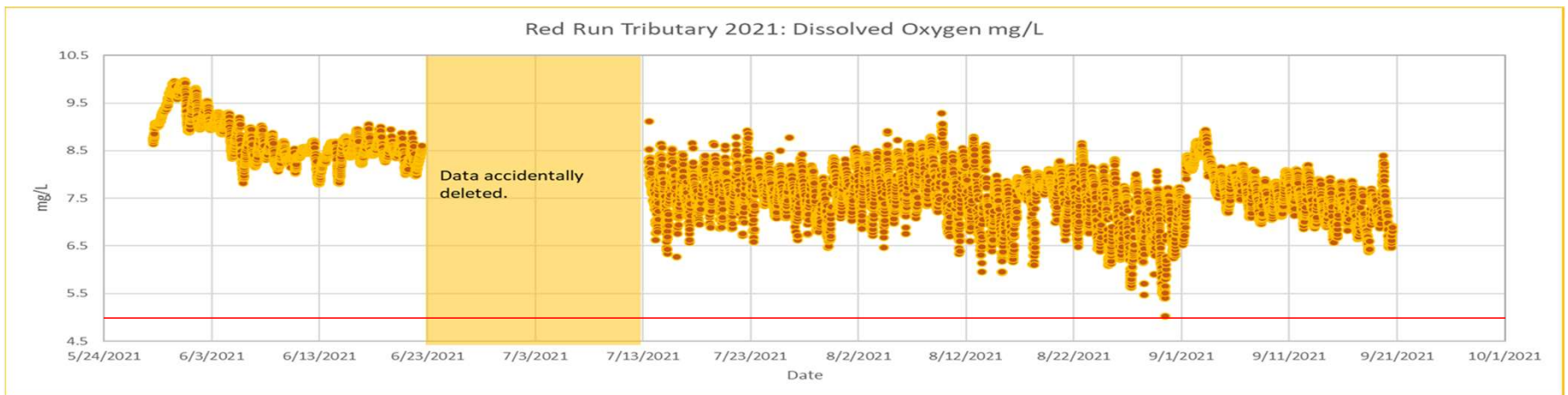
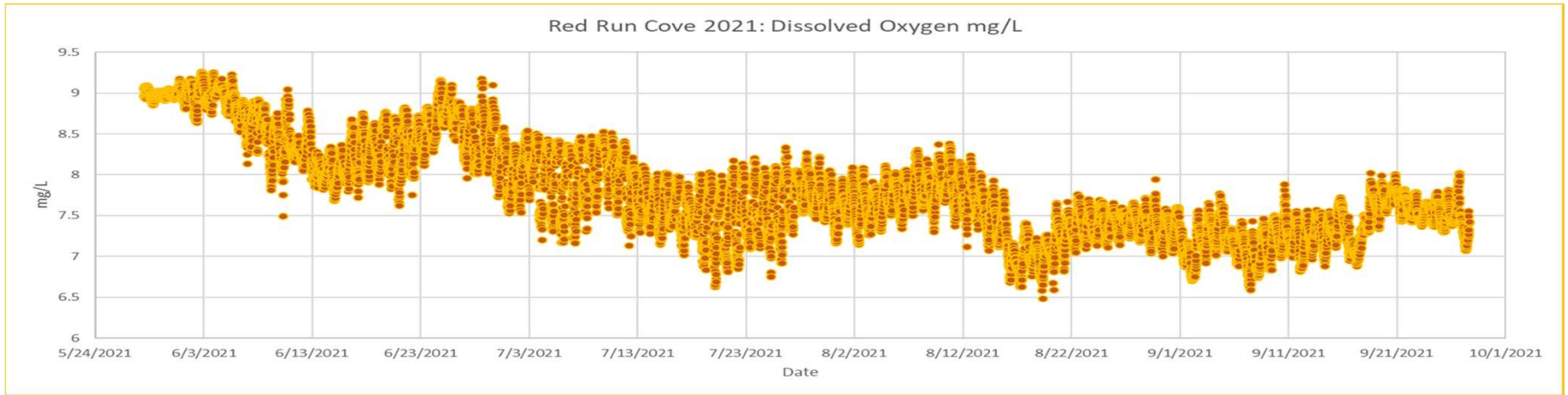
Dissolved Oxygen ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	6.40 – 10.70	8.30
Cherry Creek Cove site	5.09 – 10.43	7.82
Cherry Creek Trib site	5.50 – 10.19	7.77
Red Run Cove site	6.48 – 9.26	7.81
Red Run Trib site	5.03 – 9.97	7.84
Green Glade Cove site	4.70 – 10.89	7.90
Green Glade Trib site	5.49 – 12.47	8.09

Please note that each graph has its own range in order to get the best view of the data.

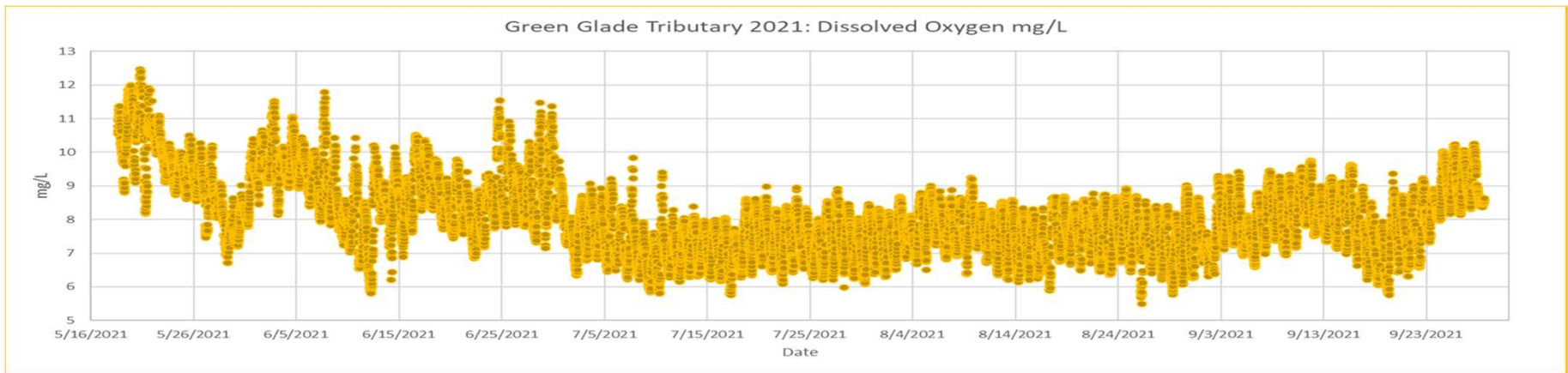
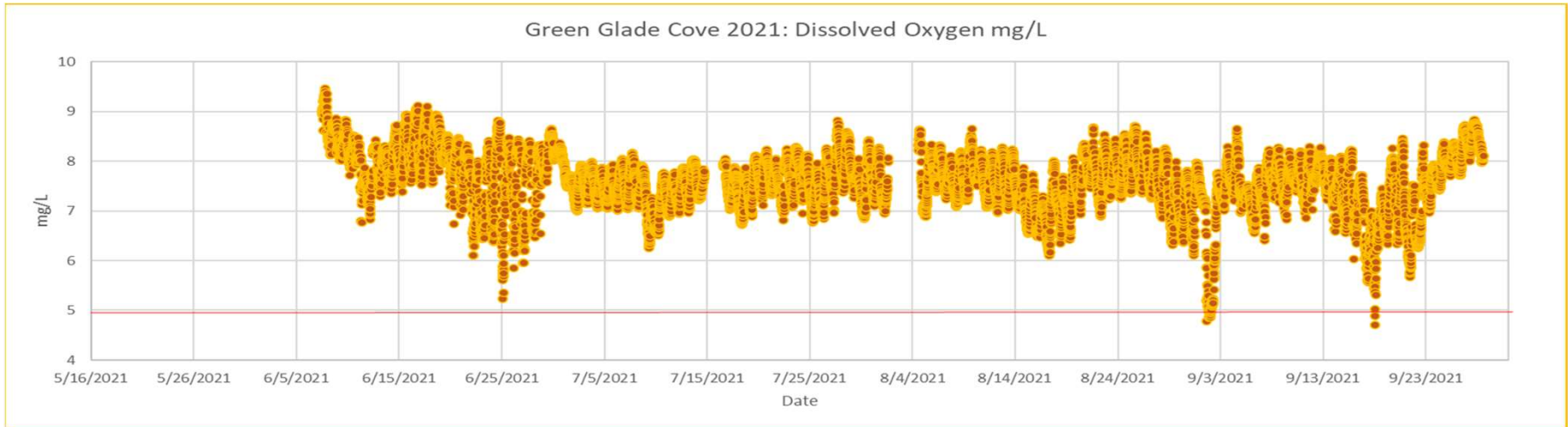
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27 / 20, 2021



Green Glade Cove May 18 – September 28, 2021



Chlorophyll

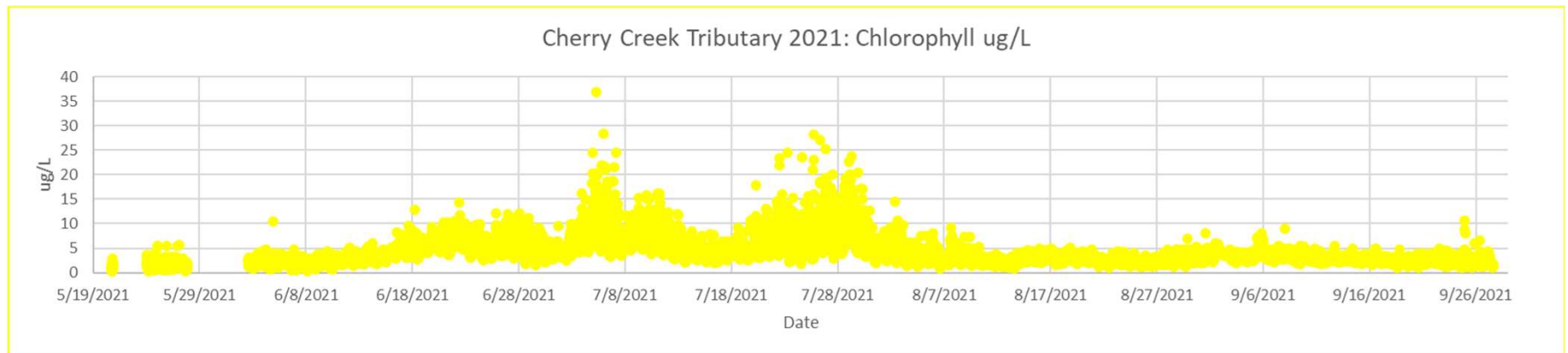
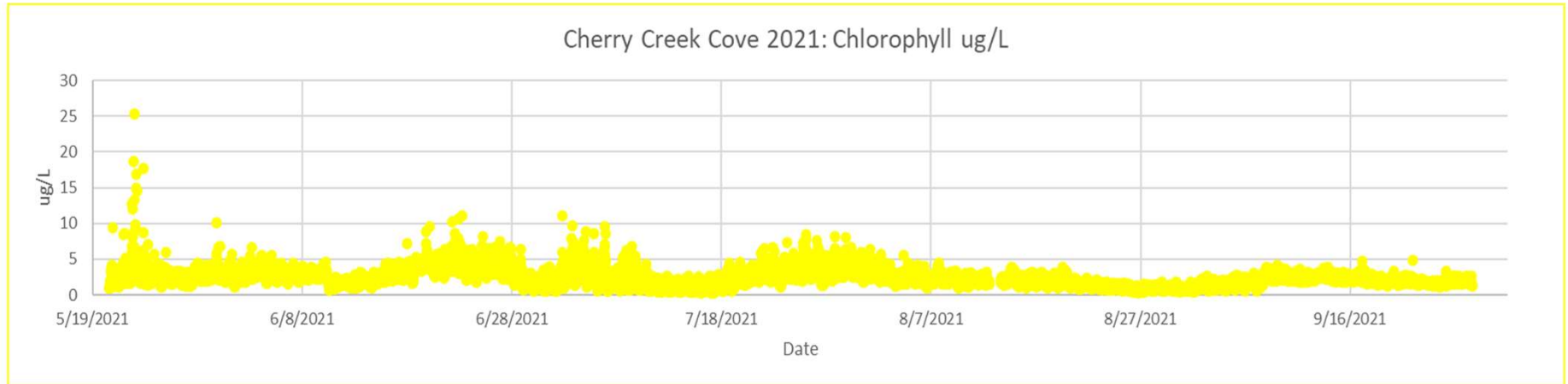
Chlorophyll: The quantity of algae in the water is measured as chlorophyll concentration (ug/l – micrograms per liter). Chlorophyll is the main chemical responsible for photosynthesis in plants, the process by which sunlight is converted into food energy. There are no hard and fast rules as to what constitutes a harmful concentration of chlorophyll but as a general guide, above 11 ug/L the chlorophyll is noticeable in the form of algal growth and above 30 ug/l represents a significant bloom. (see 2, 3, and 7 on the citations slide)

The preferred chlorophyll levels for aquatic life is below 10 ug/L. The long-term average (May – September 2017 – 2021) for Deep Creek Lake surface chlorophyll is 2.65 ug/L.

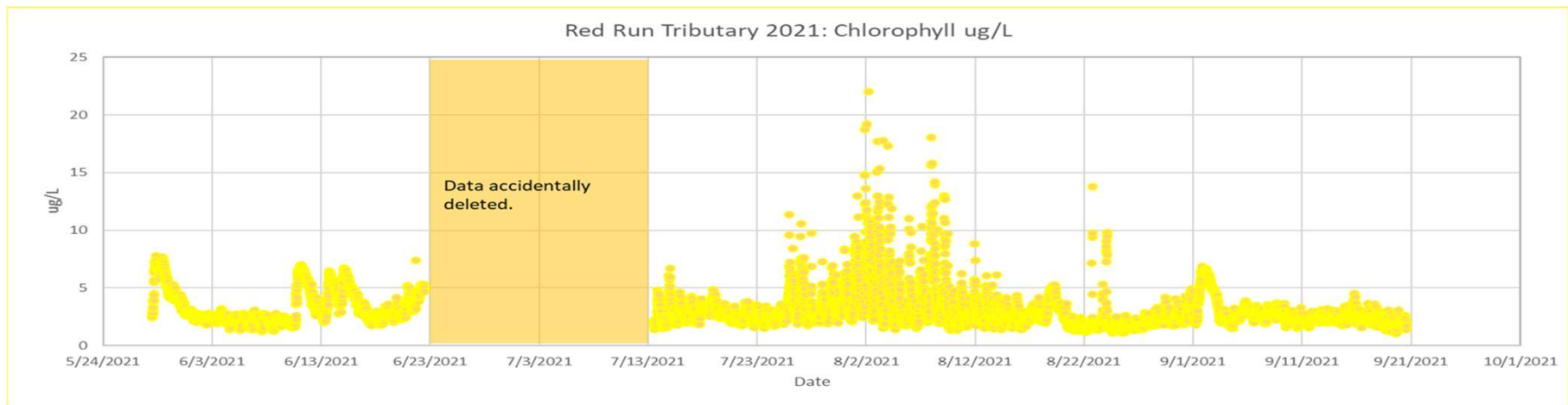
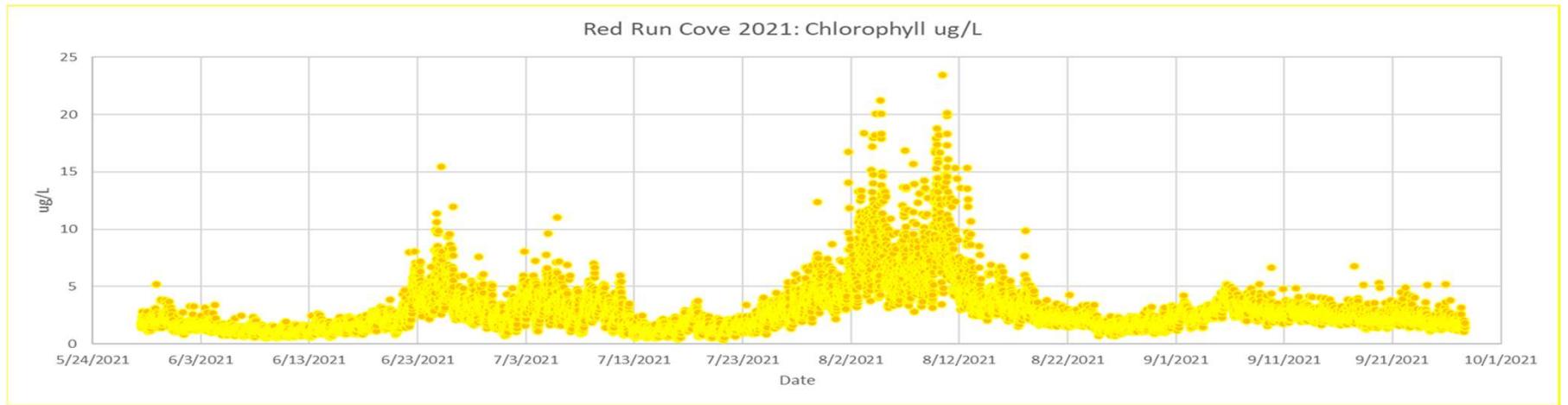
Chlorophyll ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	0.10 – 8.20	2.10
Cherry Creek Cove site	0.27 – 25.39	2.41
Cherry Creek Trib site	0.31 – 36.78	4.14
Red Run Cove site	0.39 – 23.45	2.89
Red Run Trib site	1.06 – 22.01	3.09
Green Glade Cove site	0.55 – 13.81	4.71
Green Glade Trib site	0.6 – 22.41	5.91

Please note that each graph has its own range in order to get the best view of the data.

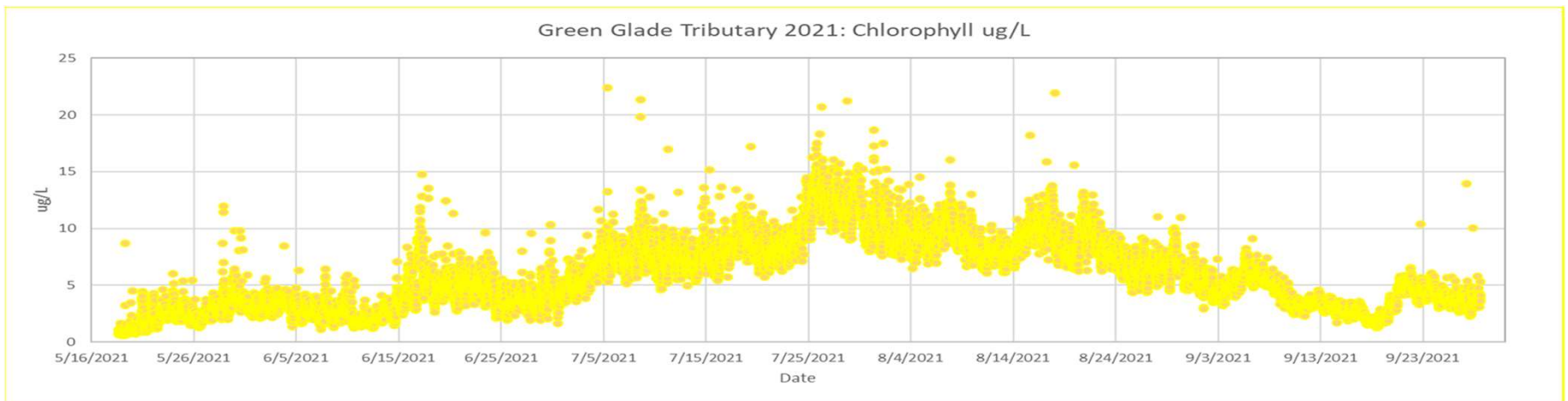
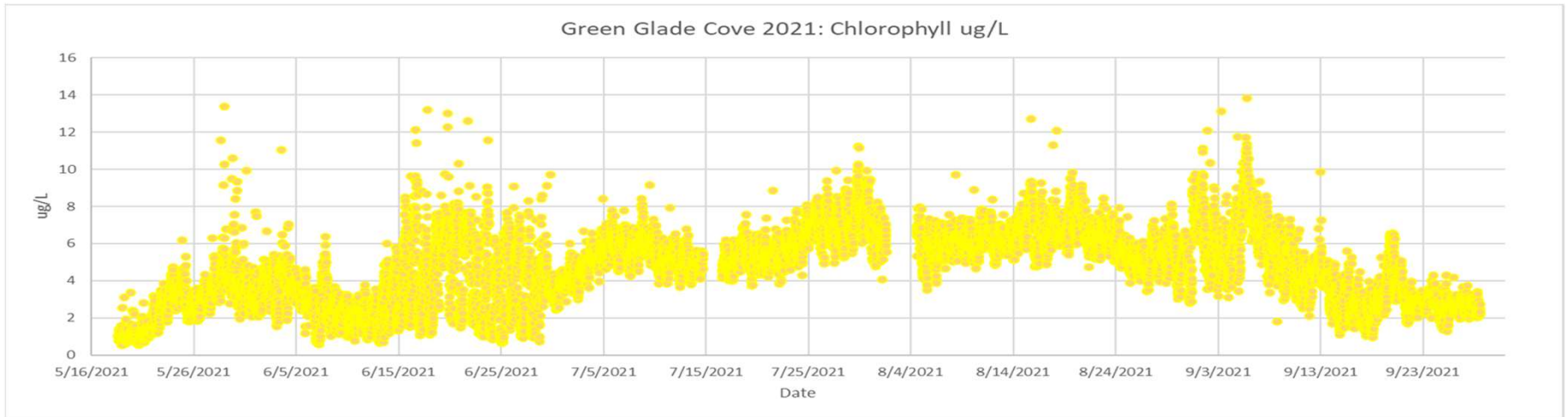
Cherry Creek Cove May 20 – September 27, 2021



Red Run Cove May 28 – September 27 / 20, 2021



Green Glade Cove May 18 – September 28, 2021



Phycocyanin

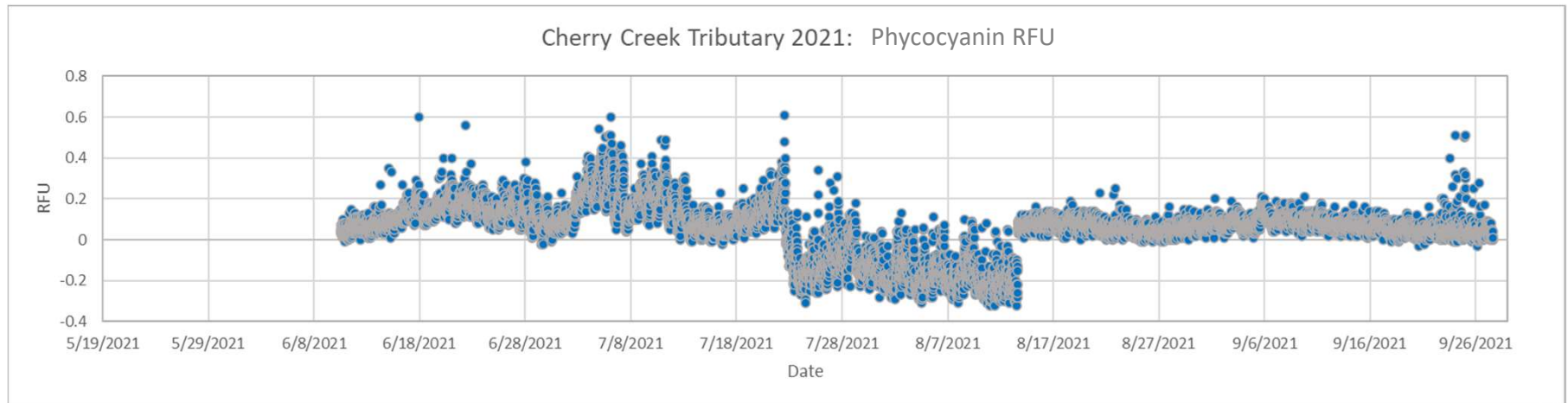
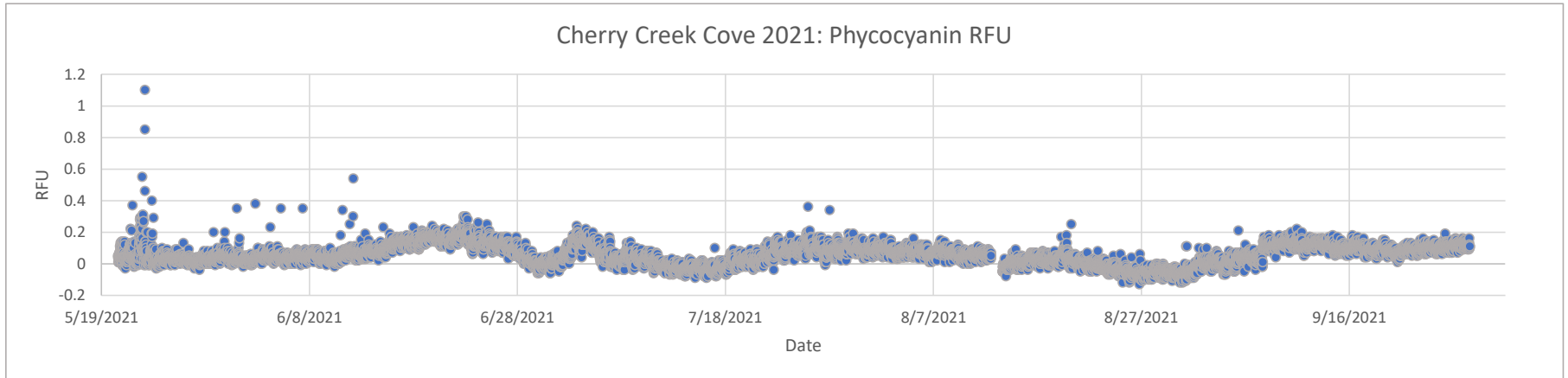
Phycocyanin: Cyanobacteria (Blue-green algae) often contain pigments such as phycocyanin. Cyanobacteria are known for their important role in noxious surface scums, known as harmful algal blooms, that form on lakes and ponds around the world. Although blue-green blooms can create nuisance conditions and undesirable water quality, most are not toxic. There are no definite rules for what is considered a harmful concentration. In general, significant deviations from the normal readings can give you an indication of when to take a sample to identify what species are present. (see 8 and 9 on the citations slide)

The preferred phycocyanin range for aquatic life is near 0 RFU. No data is available for Deep Creek Lake monthly monitoring for phycocyanin.

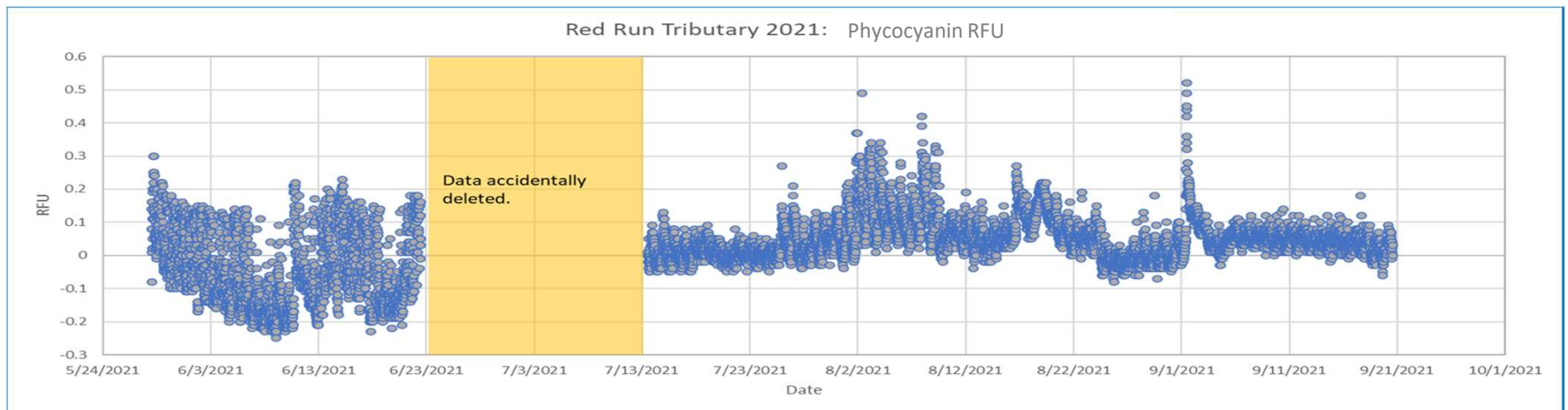
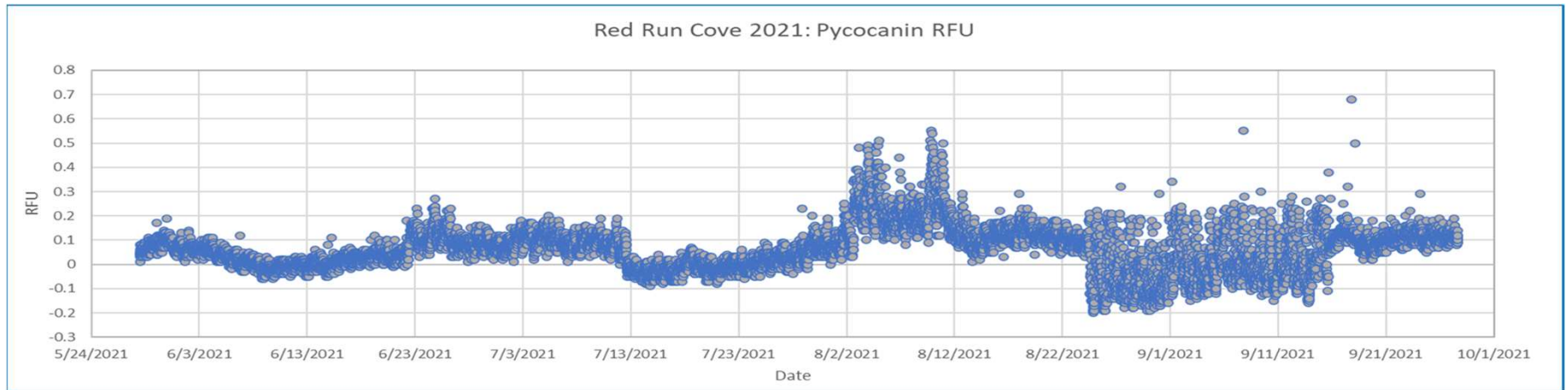
Phycocyanin ranges for DCL discrete sampling and all continuous monitoring stations during 2021		
Location	**Range during 2021	Average during 2021
*Deep Creek Lake (DCL)	N/A	N/A
Cherry Creek Cove site	0 – 1.10	0.06
Cherry Creek Trib site	0 – 0.61	0.05
Red Run Cove site	0 – 0.68	0.06
Red Run Trib site	0 – 0.52	0.03
Green Glade Cove site	0 – 0.86	0.06
Green Glade Trib site	0 – 1.36	0.29

Please note that each graph has its own range in order to get the best view of the data.

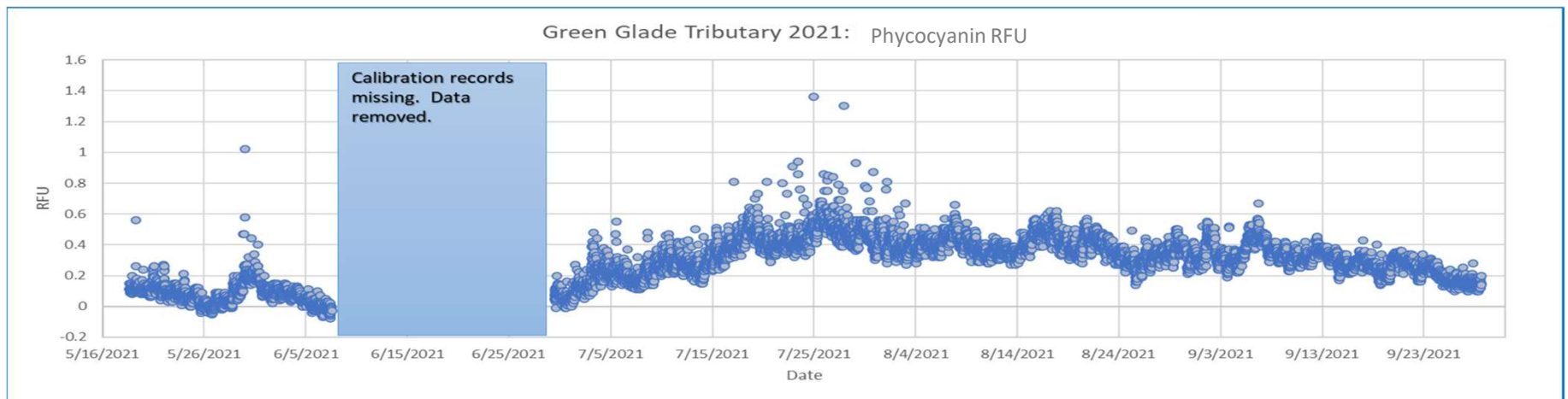
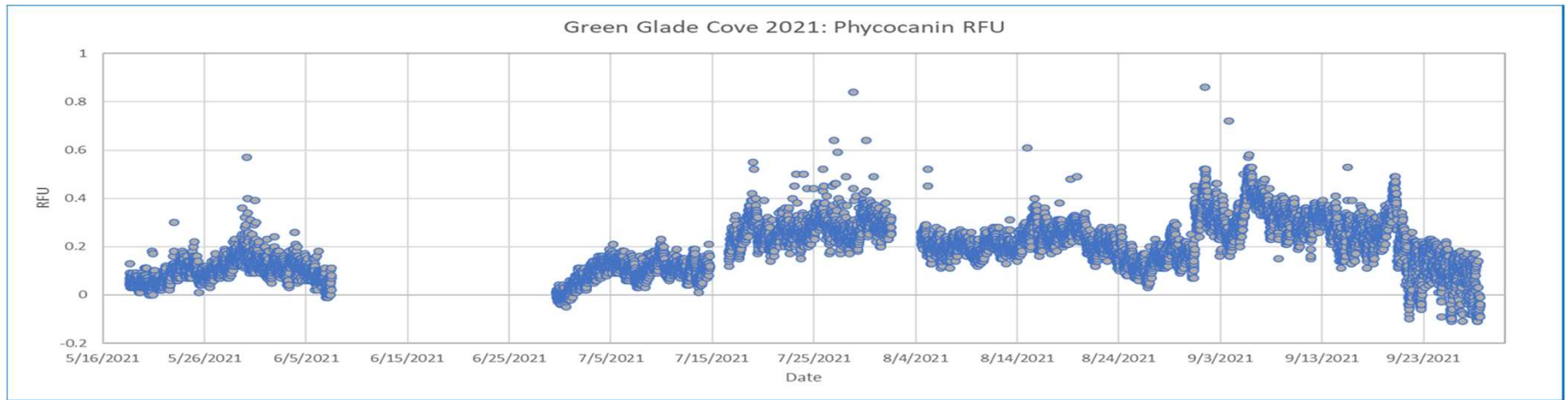
Cherry Creek Cove May 20 – September 27, 2021



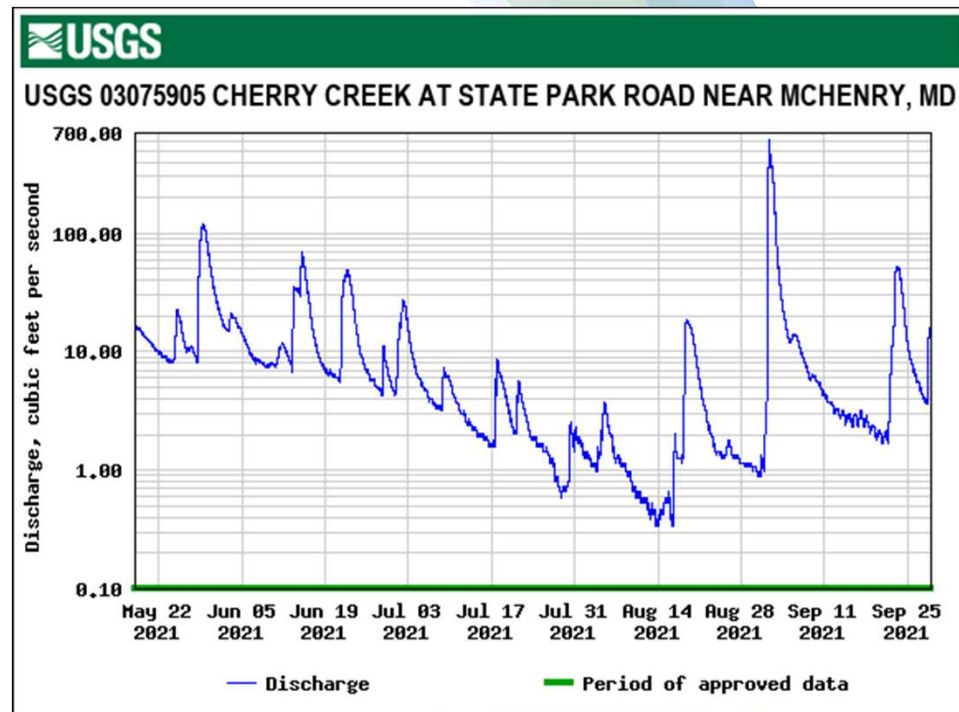
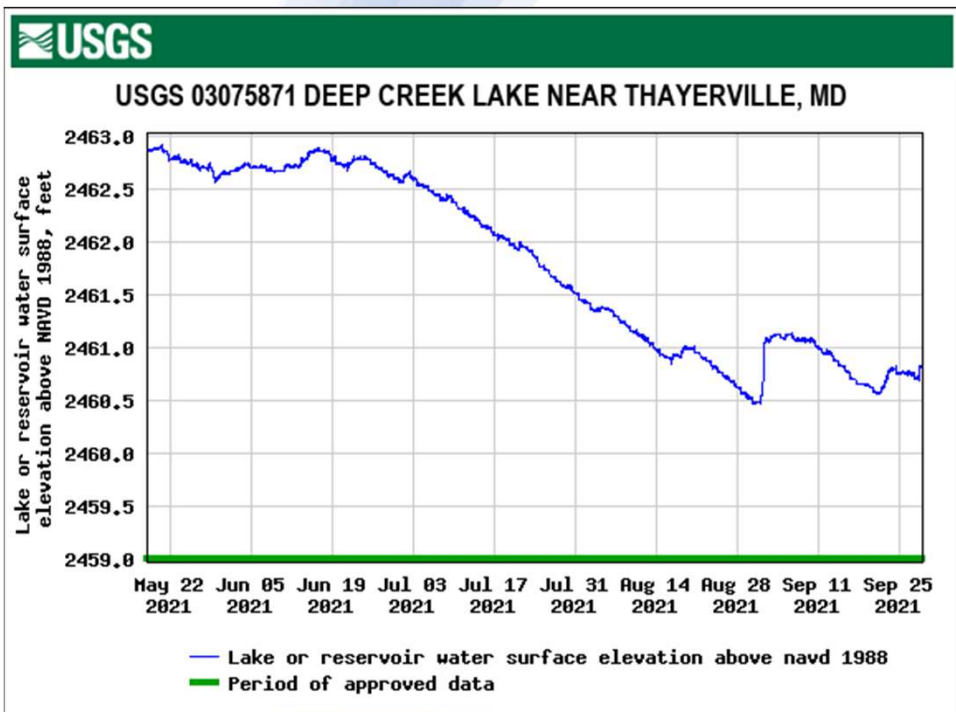
Red Run Cove May 28 – September 27/ 20, 2021



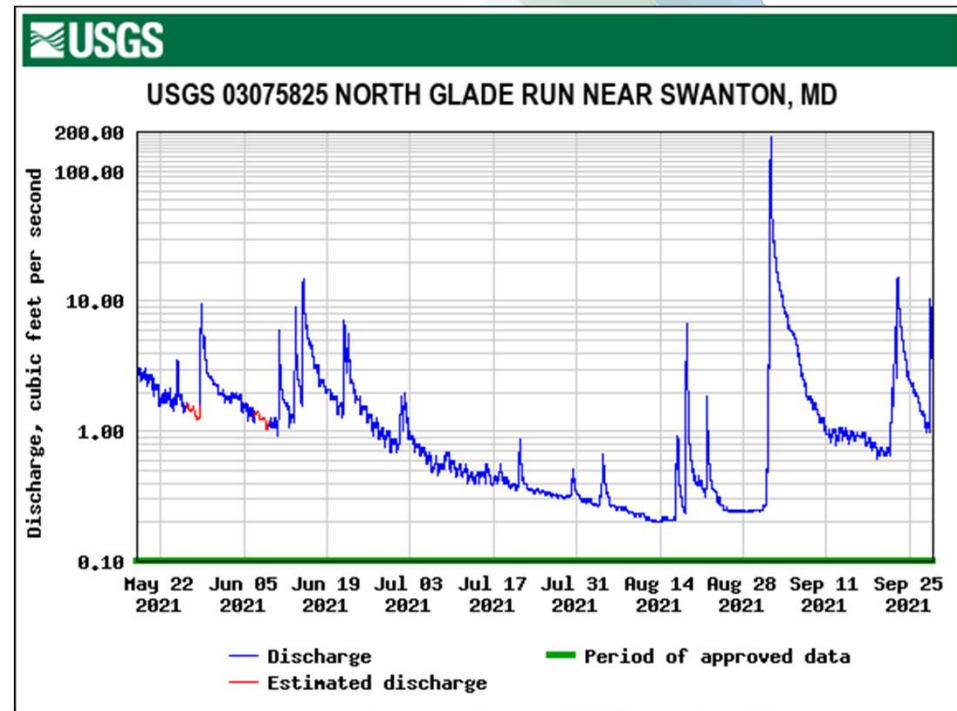
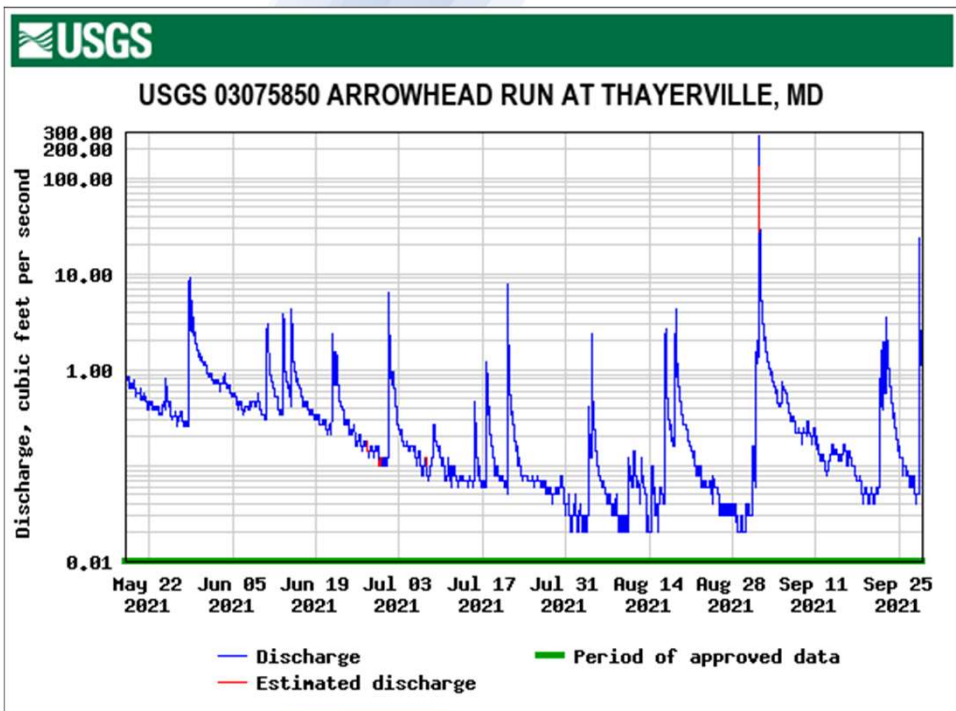
Green Glade Cove May 18 – September 28, 2021



Deep Creek Lake Continuous Monitoring 2021



Deep Creek Lake Continuous Monitoring 2021



Citations

2

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2021. Web. <<https://www.doh.wa.gov/CommunityandEnvironment/Contaminants/BlueGreenAlgae> >

- 2 I am not sure what citation usage/format is being used but here is the APA's standard: Author Last Name, First initial. (Year, Month Date Published). Title of web page. Name of Website. URL
Megan M McGinn-Meals -DNR-, 4/27/2022