Provo River Watershed

Water Quality Report

CENTRAL UTAH WATER

CONSERVANCY DISTRICT

2020

Prepared by,

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Water Quality Scientist

Water quality in Jordanelle Reservoir, Deer Creek Reservoir and the Provo River was analyzed for the year 2019. This report includes the following water quality parameters: phytoplankton, total phosphorus (TP), nitrate (NO_3), total organic carbon (TOC), and Trophic State Index (TSI). To determine long-term trends of nutrient and total organic carbon data they were compared to the seven previous years.

JORDANELLE

Water samples were collected from above the Jordanelle Reservoir dam at each gate elevation of the Select Level Out Works (SLOW). Samples were also collected from the Provo Arm and North Arm of Jordanelle, however, the samples collected from above the dam are the only ones represented in this report.

Phytoplankton

Currently there are no state or federal regulations that determine when algae begin to inhibit water quality. However, there is a current World Health Organization (WHO) guideline that states when cyanobacteria cell counts exceed 20,000 cells/mL it creates a negative impact on water quality as well as a potential threat to human health.

The most dominant phytoplankton taxon in Jordanelle Reservoir were diatoms (see figures 1-3). While the amount and diversity of diatoms decreased farther down in the water column, they were found at each of the gate depths. The most abundant diatom samples were collected during the month of November. Green algae were also found throughout the water column however at significantly lower amounts than the diatoms (see figure 2). Cyanobacteria were present in two samples collected in 2019 with gate 4 of the SLOW tower experiencing the highest value in August with 196 cells/mL (see figure 3).

Figure 1

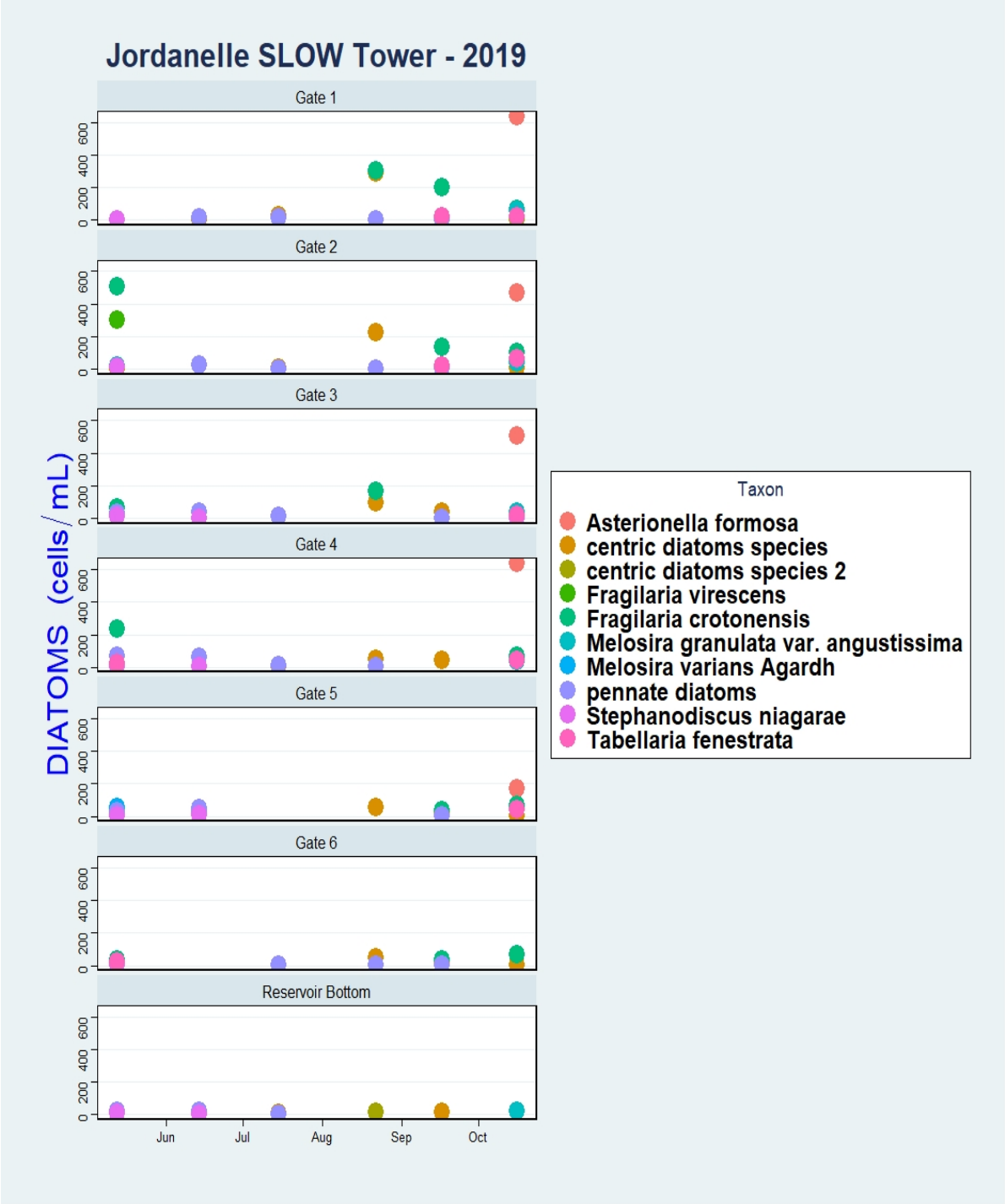

Figure 1: Diatom Taxon found in the bottom of the water column and at each of the SLOW tower gate depths. Diatoms were most abundant during the month of November.

Figure 2

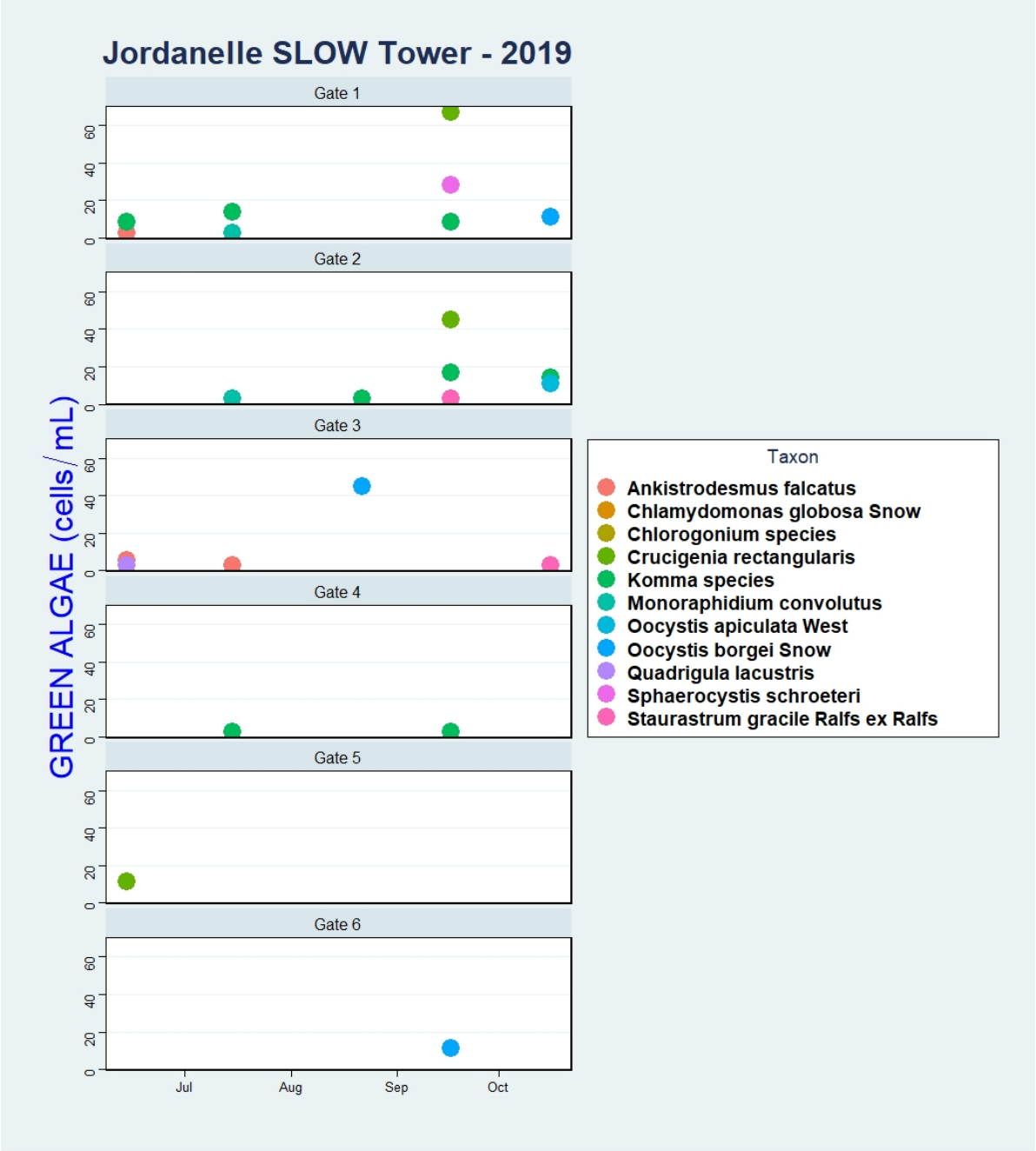

Figure 2: Green Algae Taxon found at each of the SLOW tower gate depths.

Figure 3

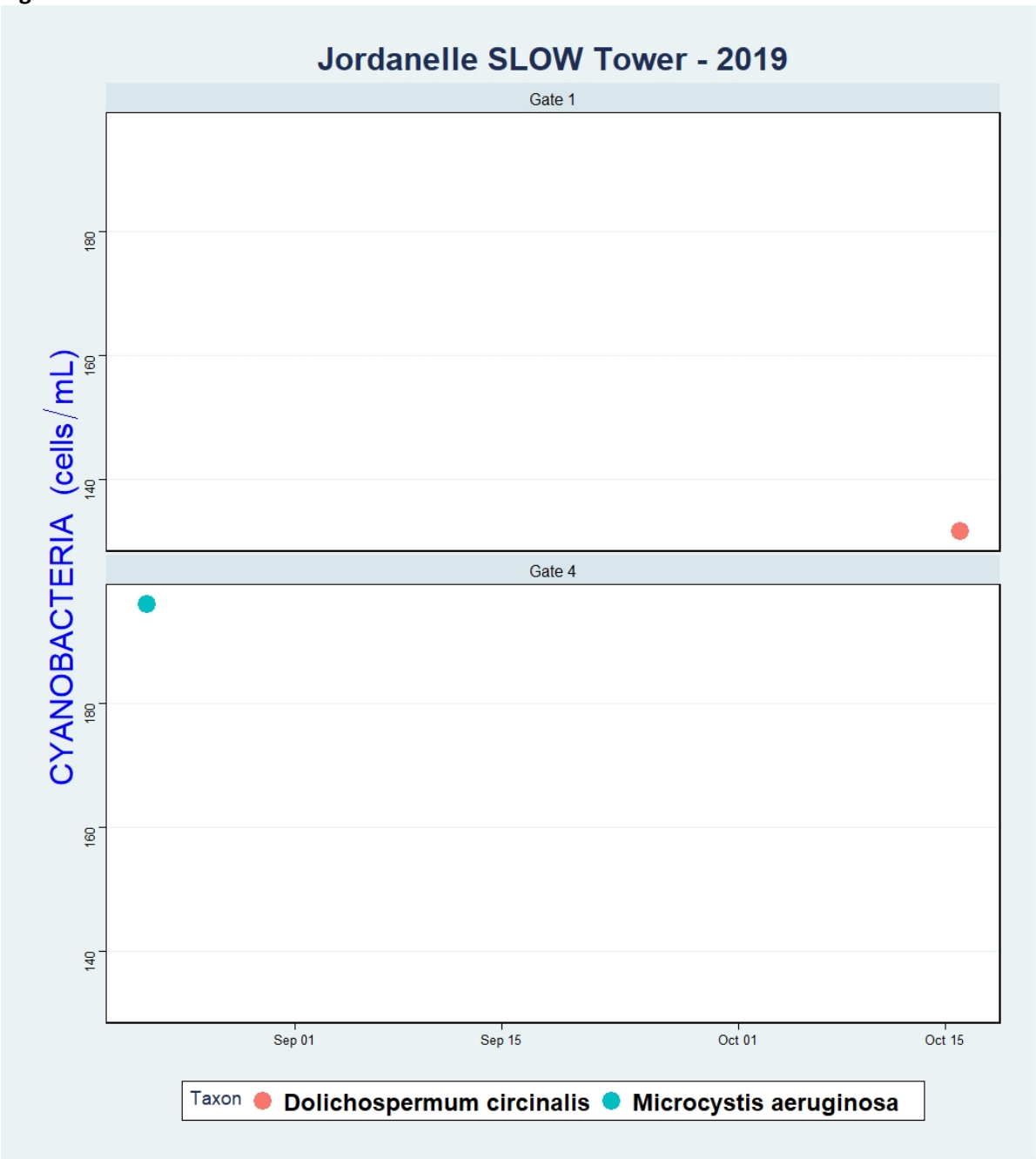

Figure 3: Cyanobacteria Taxon found above the Jordanelle dam. Cyanobacteria were only found from gates 1 and 4 samples during the 2019 sample season.

Nutrients

Nutrients were measured from SLOW tower gate depths. These values were averaged together to give a single value.

The Division of Water Quality has determined that Total Phosphorus (TP) levels start to impact water quality at 0.025 mg/L and Nitrate (NO_3) influences water quality at 4 mg/L. Over the last eight years total phosphorus was exceeded one time in the fall of 2016 when it measured 0.026 mg/L (see figure 4). Nitrate levels in Jordanelle have consistently remained low (see figure 5) throughout the water column.

Figure 4

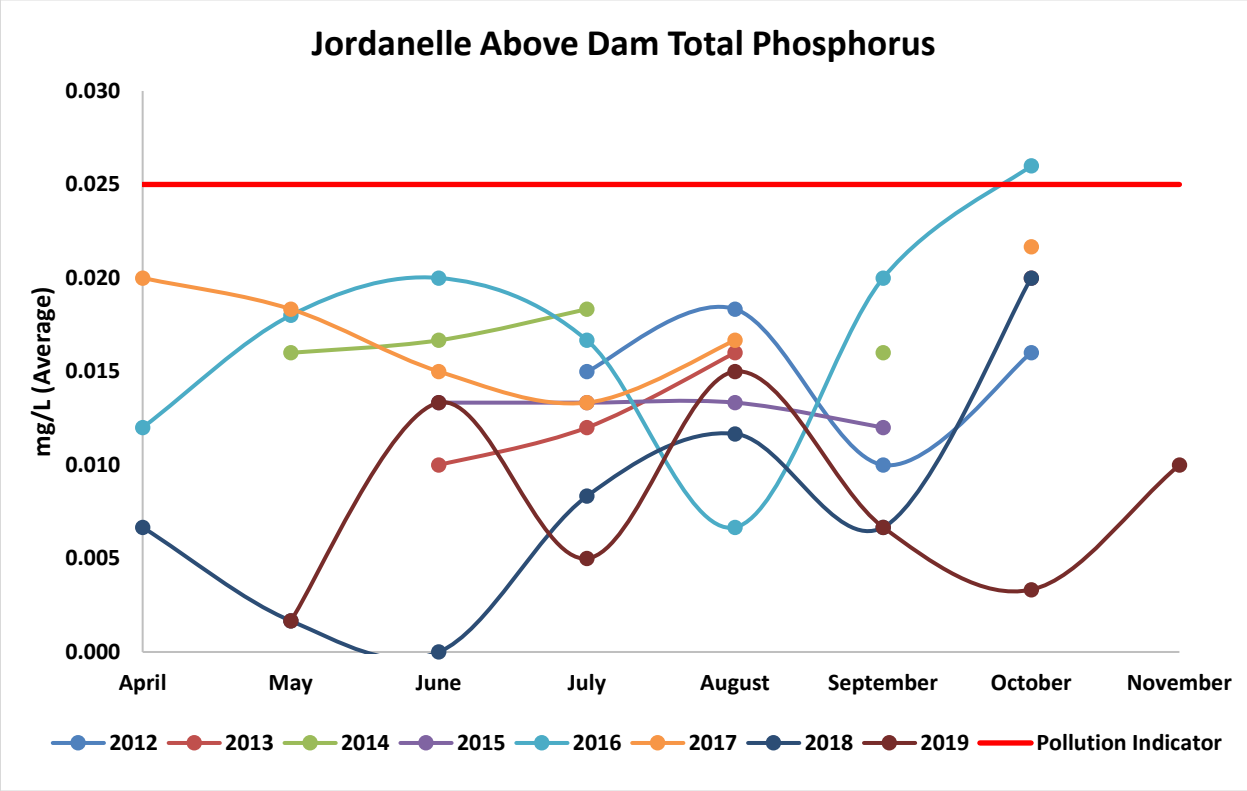

Figure 4: Average total phosphorus values above Jordanelle dam. In 2016 the total phosphorus peaked at 0.026, slightly above the Division of Water Quality pollution indicator of 0.025.

Figure 5

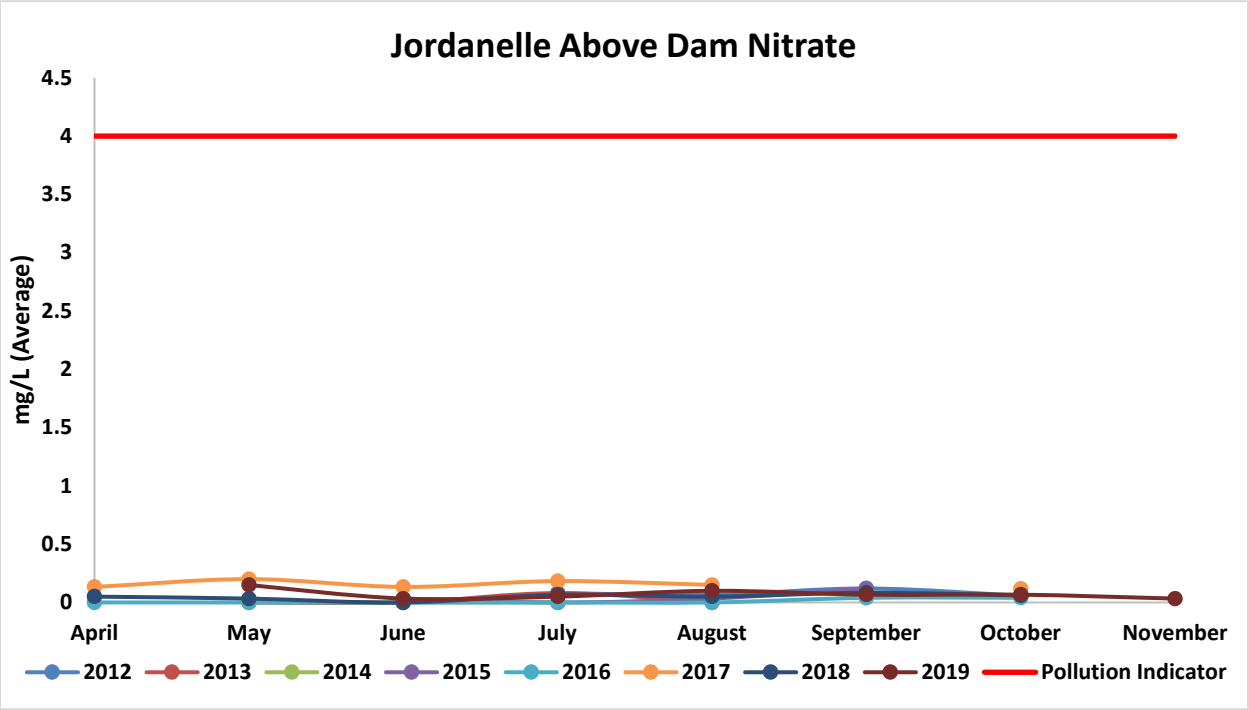

Figure 5: Average nitrate values above Jordanelle dam. Nitrate values have remained low during the last eight years.

Total Organic Carbon

Total Organic Carbon (TOC) is a parameter that influences disinfection by-products (DBP) in drinking water. The higher the concentrations of TOC the greater the probability of DBPs forming in finished drinking water.

It should be noted that TOC samples were not collected at the different gate depths until 2014. Total organic carbon levels in Jordanelle have remained low with values ranging from 2.1 mg/L to 4.6 mg/L over the last six years (see figure 6).

Figure 6

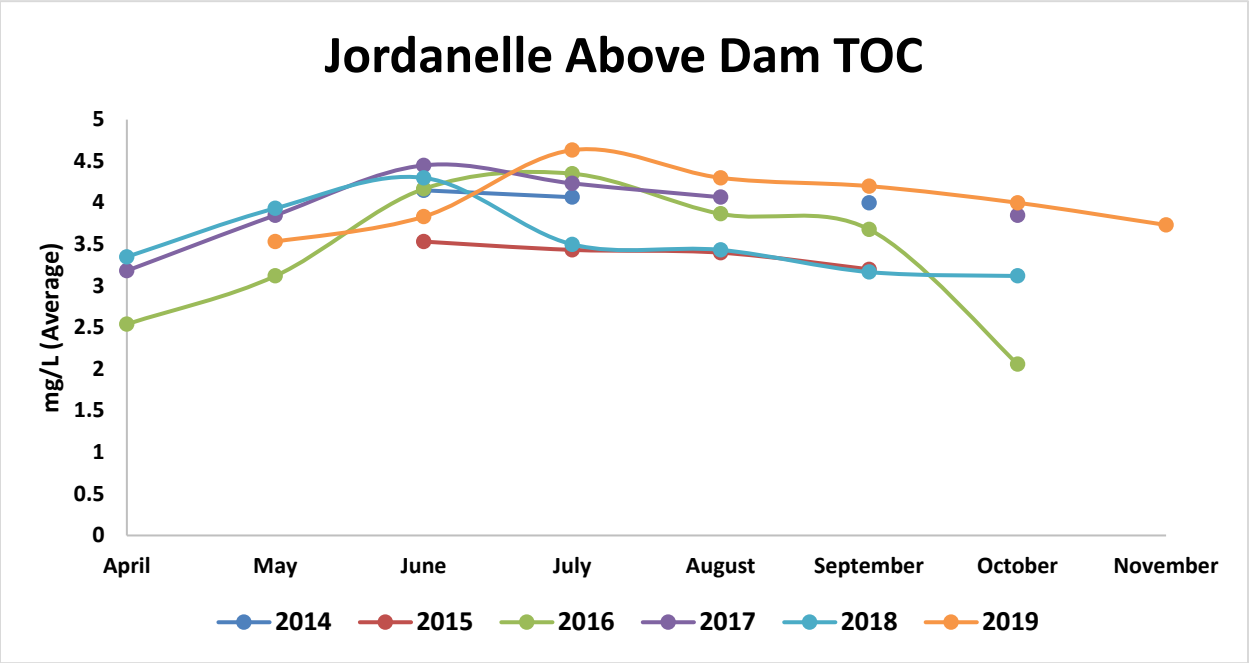

Figure 6: Average TOC values above Jordanelle Dam.

Trophic State Index

The aquatic ecosystem productivity of a lake is often described by the terms: oligotrophic, mesotrophic, and eutrophic. Oligo, as a prefix means, "few" and trophic is defined as: " relating to nutrition (or food)," thus oligotrophic means "little food" and eutrophic means "many foods" with mesotrophic being in the middle.

The Trophic State Index (TSI) is a tool that classifies lakes and reservoirs into different trophic levels. It is often calculated via secchi depth, and phytoplankton biomass (chlorophyll *a*). Generally, the lower the TSI the greater the water clarity and the lower the phytoplankton biomass. A TSI value greater than 50 is considered Eutrophic, a value greater than 40 and less than 50 is Mesotrophic, and a value less than 40 is Oligotrophic. The State of Utah has a goal for state reservoirs to fall within the Mesotrophic range. For the last several years Jordanelle Reservoir has varied between Mesotrophic and Oligotrophic (see figure 7). Based on the variableness of the chlorophyll *a* and secchi disk data I am comfortable declaring Jordanelle as a Mesotrophic Reservoir.

Figure 7

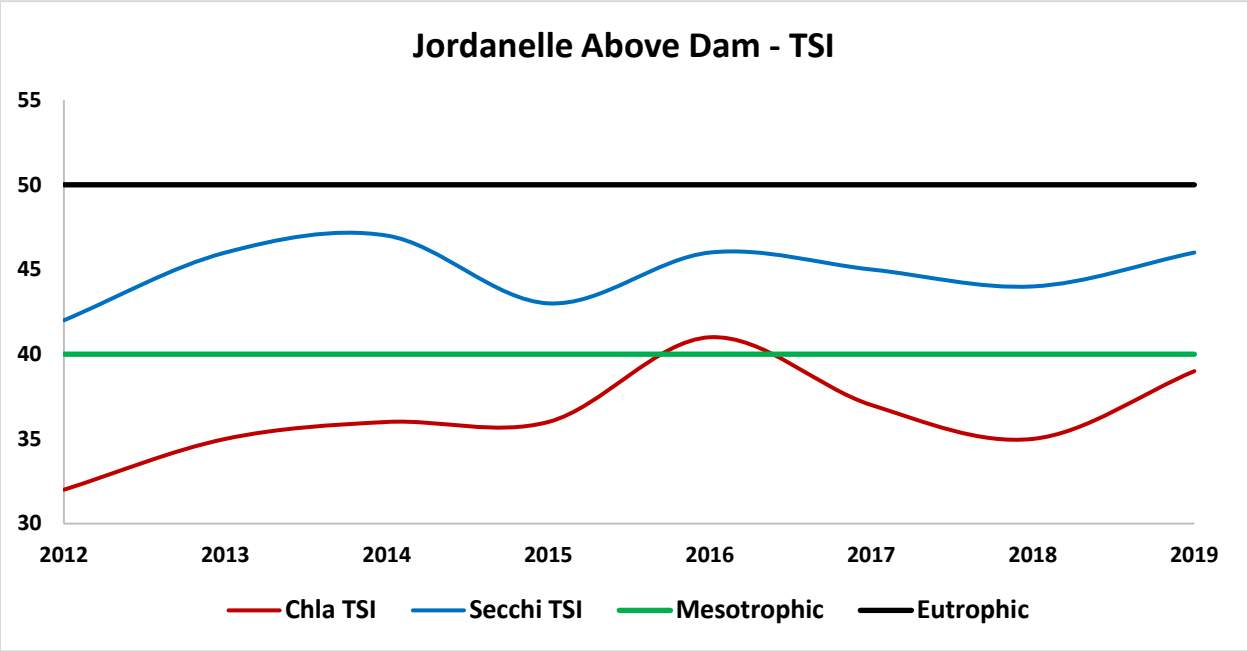

Figure 7: Trophic State Index for Jordanelle Reservoir for the last 8 years. The trend is varying between Oligotrophic and Mesotrophic.

DEER CREEK

Water samples were collected from Deer Creek Reservoir Above Dam, Mid Lake, Upper End, and Wallsburg Bay sites. Phytoplankton samples were collected from the surface of the water, the secchi depth, at the elevation of the outlet works from the Above Dam sample site, 1 meter above the bottom of the reservoir. Nutrient and TOC samples were collected and averaged from a two-meter composite surface sample, above and below the thermocline (when present in the water column), at the elevation of the outlet works from the Above Dam sample site and a sample collected within 1 meter of the bottom of the reservoir. Phytoplankton samples collected from each location are represented in this report, however, nutrient, TOC, and trophic state data are only represented by the Above Dam location.

Phytoplankton

Diatoms and Green Algae were found in the water column throughout the entire sample season at all the sample locations (see figures 8 and 9). Cyanobacteria was found at each location with the greatest number of cells collected at the Midlake site during the month of September with 6006 cells/mL of Lyngbya birgei (see figure 10).

Figure 8

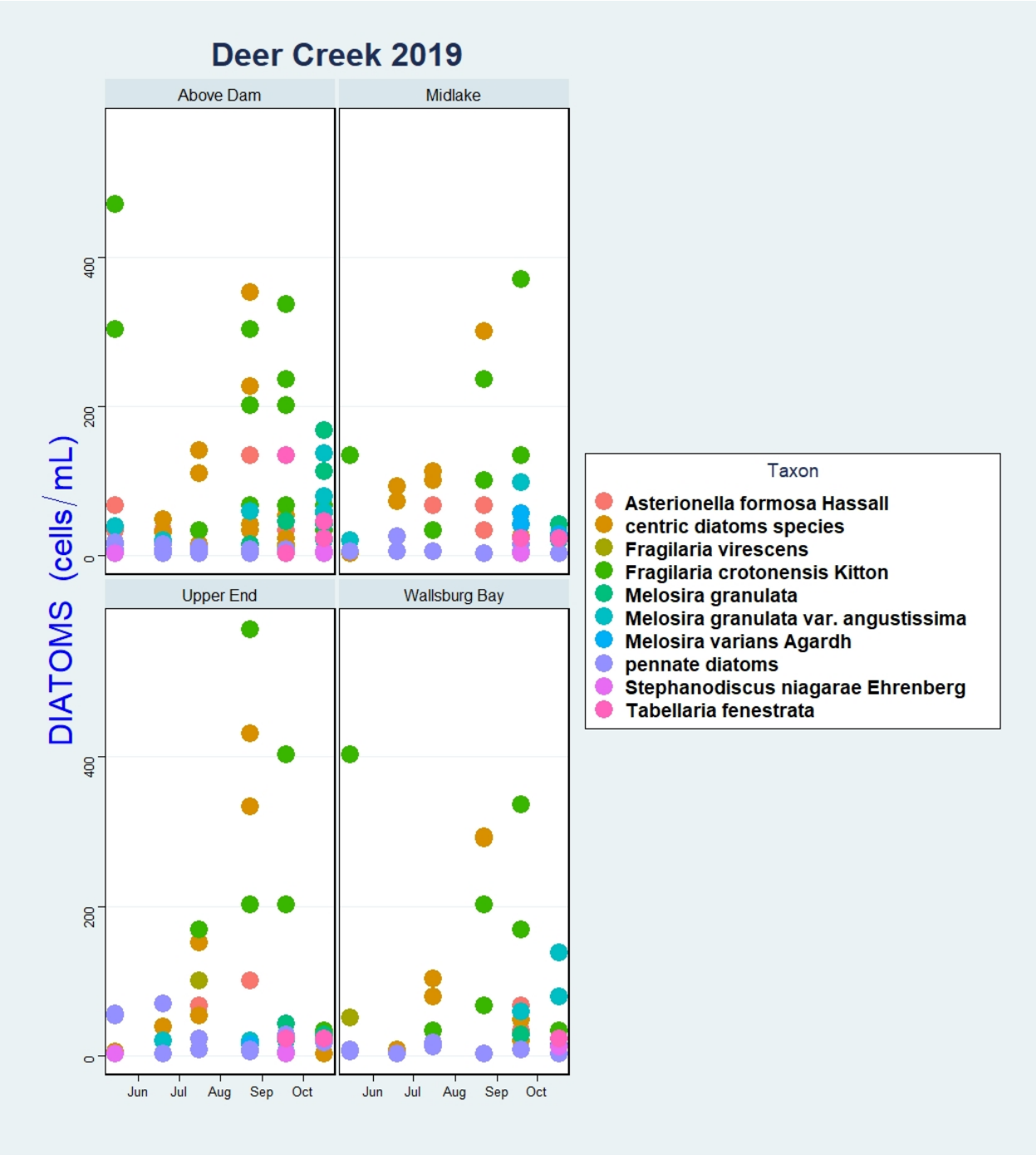

Figure 8: Diatom cell counts at the individual Deer Creek sample locations.

Figure 9

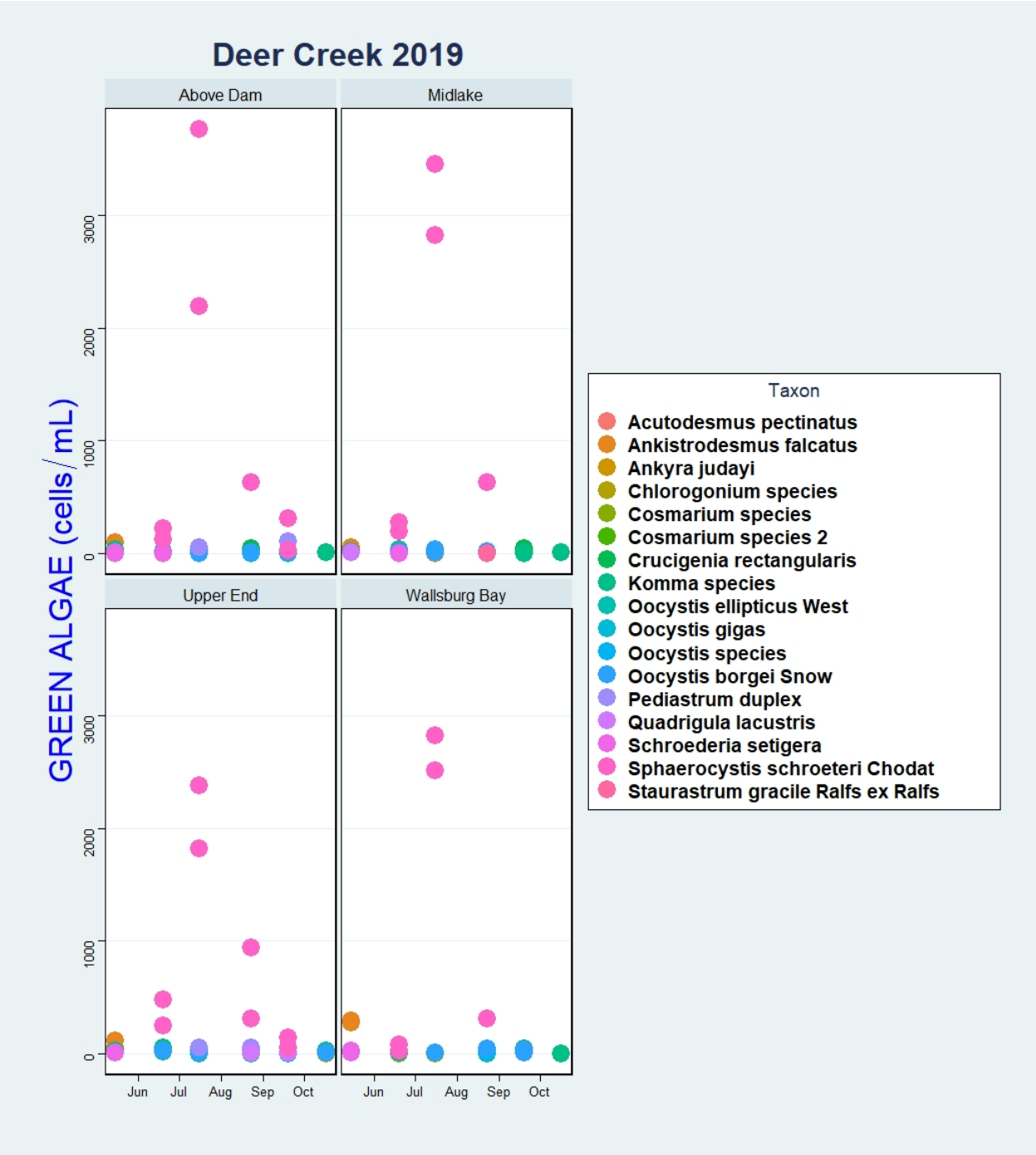

Figure 9: Green Algae cell counts from the individual Deer Creek sample locations.

Figure 10

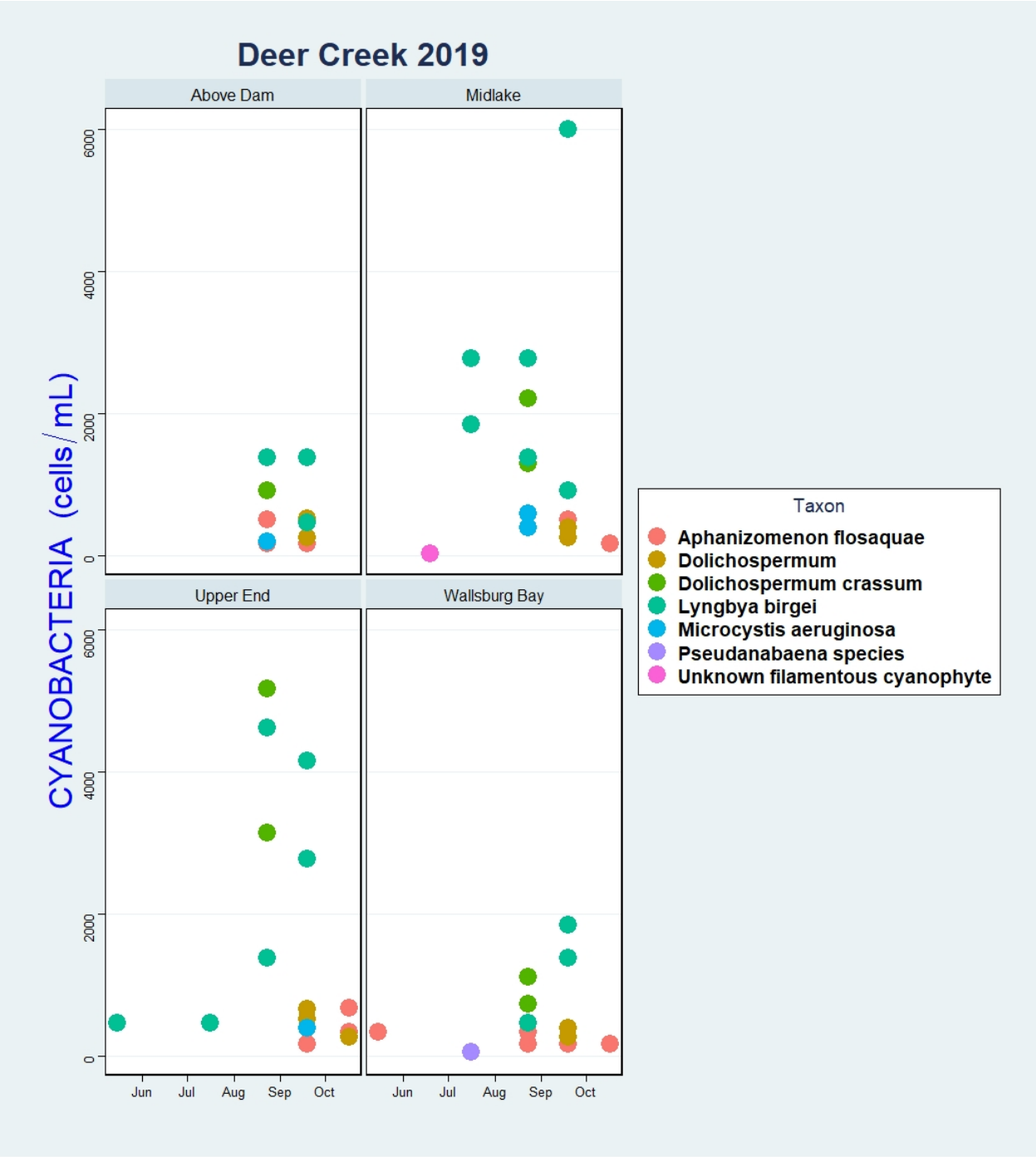

Figure 10: Cyanobacteria cell counts from the individual Deer Creek sample locations.

Nutrients

Nutrients values were averaged together to give a single value for the Above Dam sample location. Over the last eight years the TP concentration has often exceeded the State pollution indicator with the highest average peak of 0.068 mg/L in August 2012 (see figure 11). Nitrate levels over the last eight years have stayed well below the State pollution indicator of 4 mg/L (see figure 12).

Figure 11

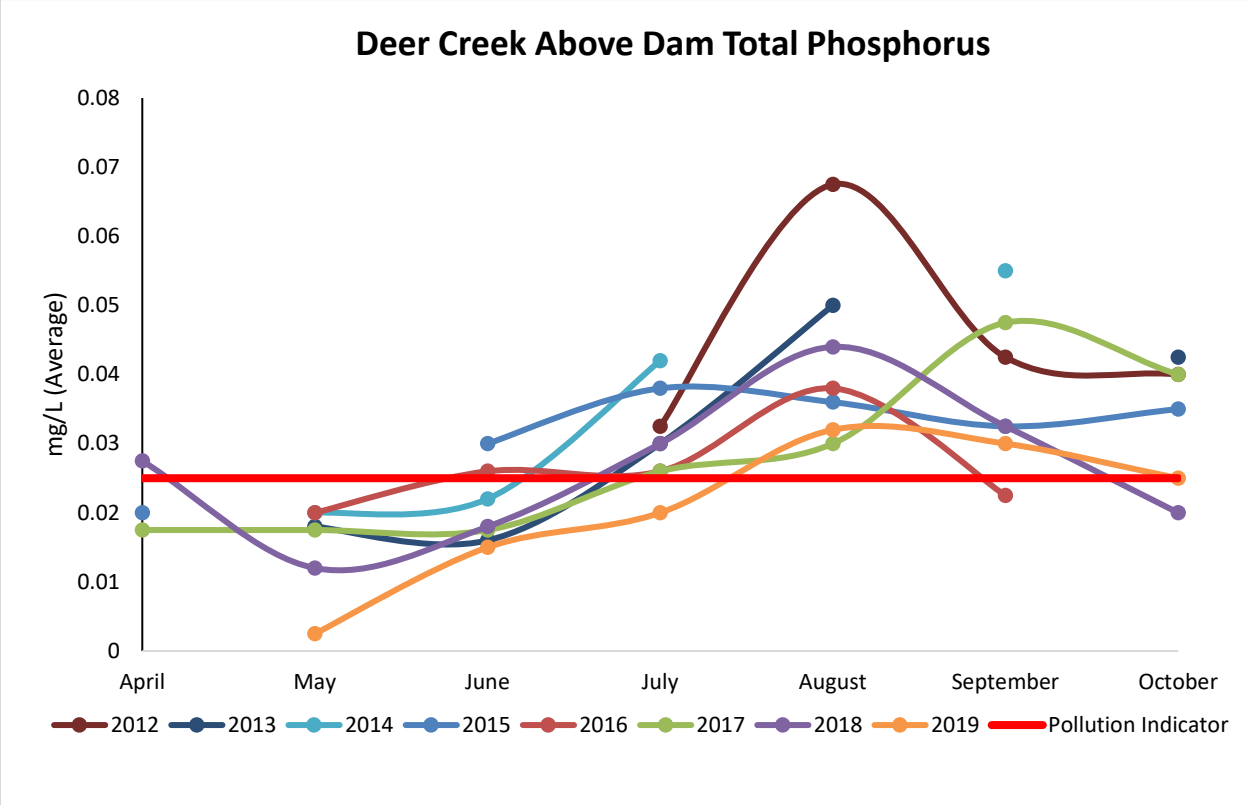

Figure 11: Total phosphorus concentrations in Deer Creek Reservoir Above Dam.

Figure 12

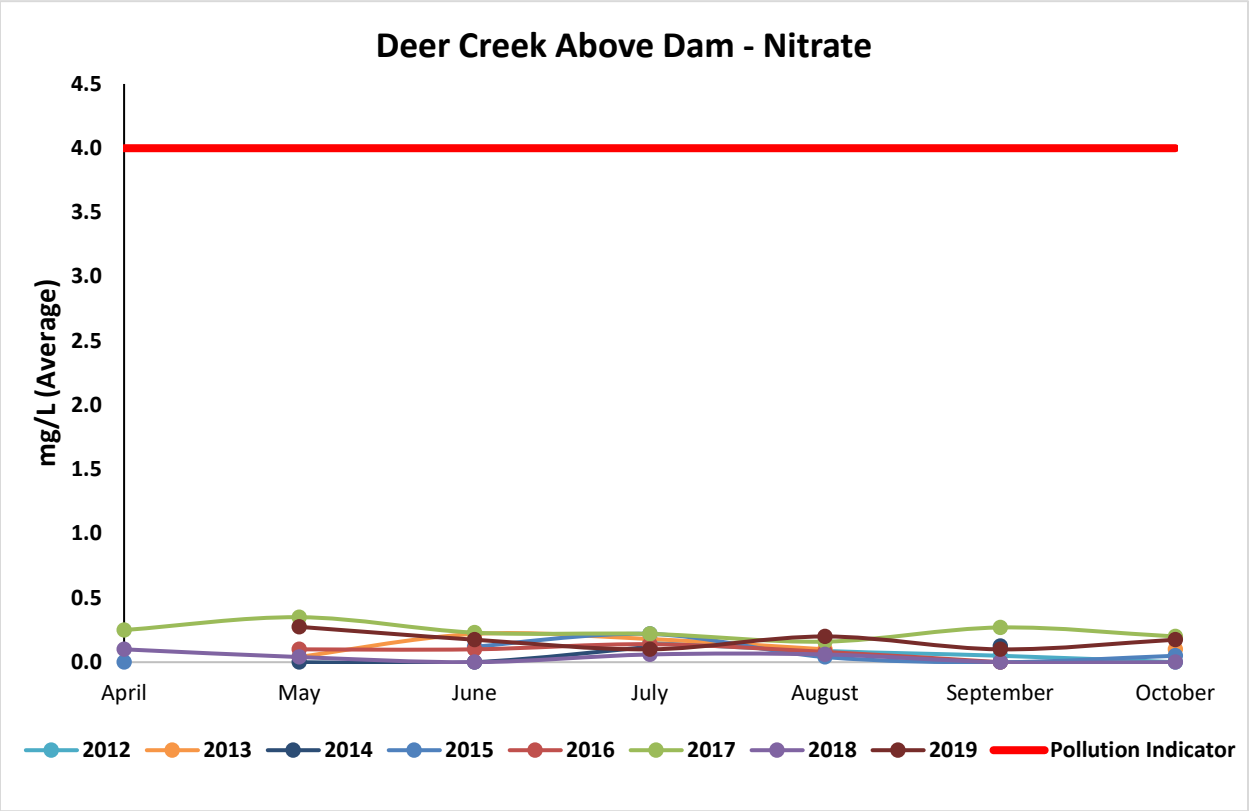

Figure 12: Nitrate concentration in Deer Creek Reservoir Above Dam.

Total Organic Carbon

Total organic carbon levels in Deer Creek have remained low with values ranging from 2.4 mg/L to 4.1 mg/L over the last eight years (see figure 13).

Figure 13

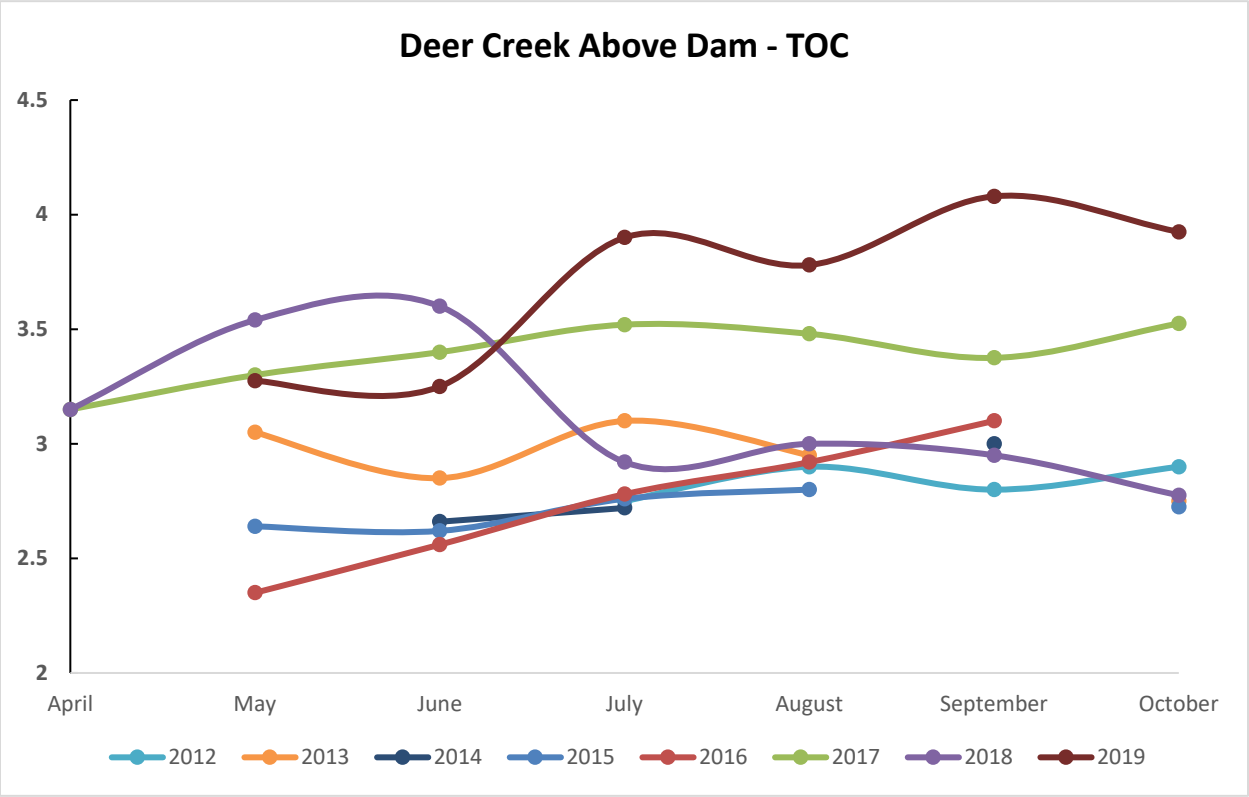

Figure 13: Total Organic Carbon concentrations for Deer Creek above the dam. The TOC values

Trophic State Index

Since 2012 Deer Creek Reservoir has varied between Oligotrophic and Mesotrophic (Figure 14). Based on the variableness of the chlorophyll *a* and secchi disk data I would be comfortable declaring Deer Creek as a Mesotrophic Reservoir.

Figure 14

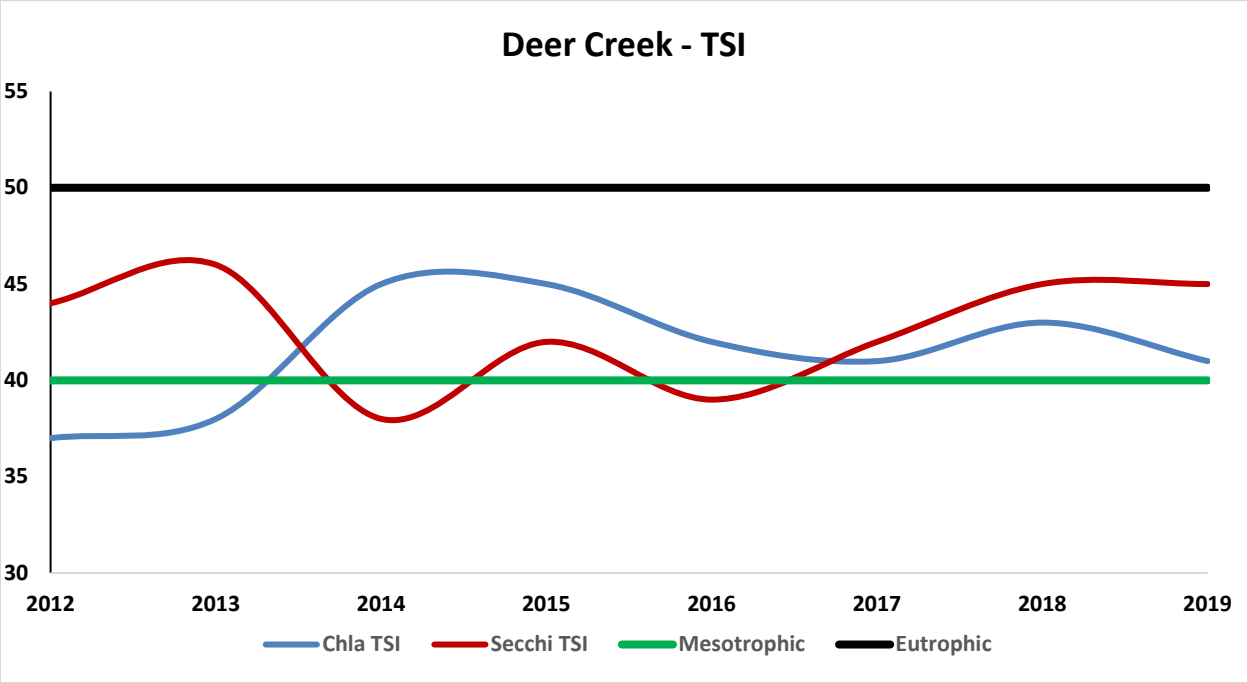

Figure 14: Trophic State Index for Deer Creek Reservoir

PROVO RIVER

Water samples were collected from 21 sample locations from the Provo River during 2019. Data in this report only includes data from six of those locations: Above Deer Creek, Above Jordanelle, Below Deer Creek, Below Jordanelle, Murdock Diversion, and Olmsted Diversion.

Phytoplankton

Phytoplankton taxa values were plotted as cells/mL from the surface water samples collected from the Provo River (see figures 15-17). Cyanobacteria was only detected four times during 2019 (see figure 17).

Figure 15

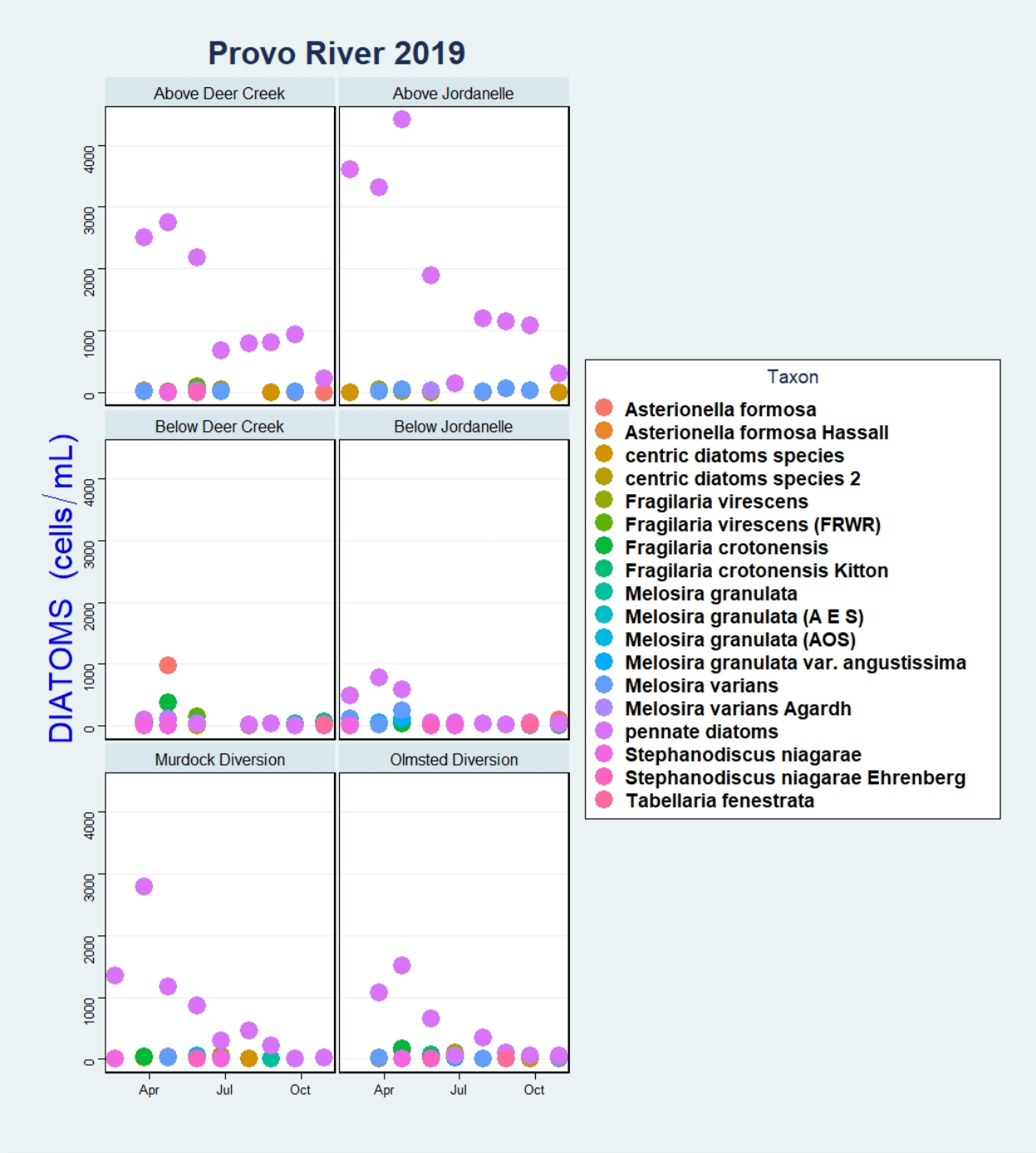

Figure 15: Diatoms cell counts from the Provo River in 2019.

Figure 16

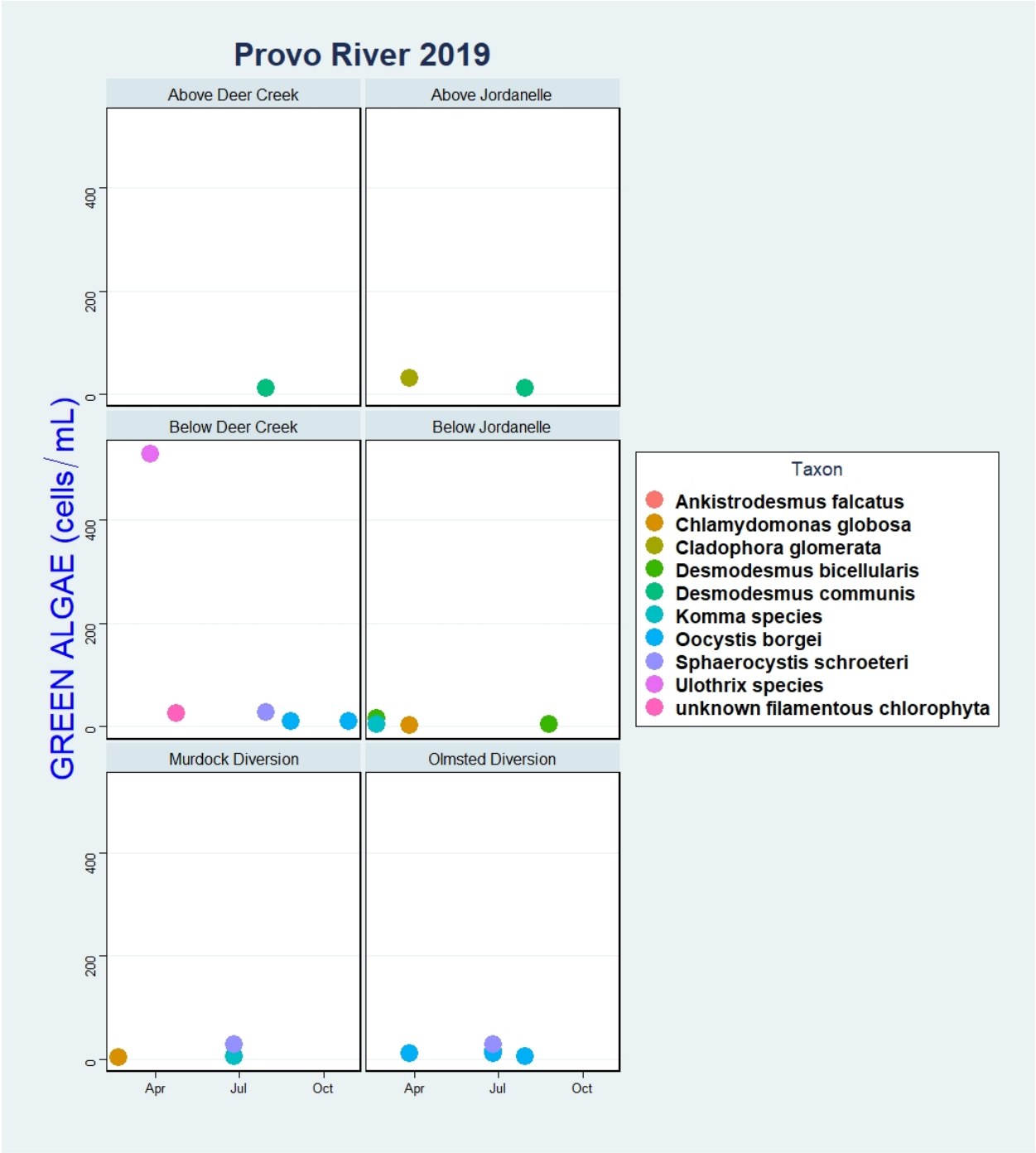

Figure 16: Green Algae cell counts from the Provo River in 2019.

Figure 17

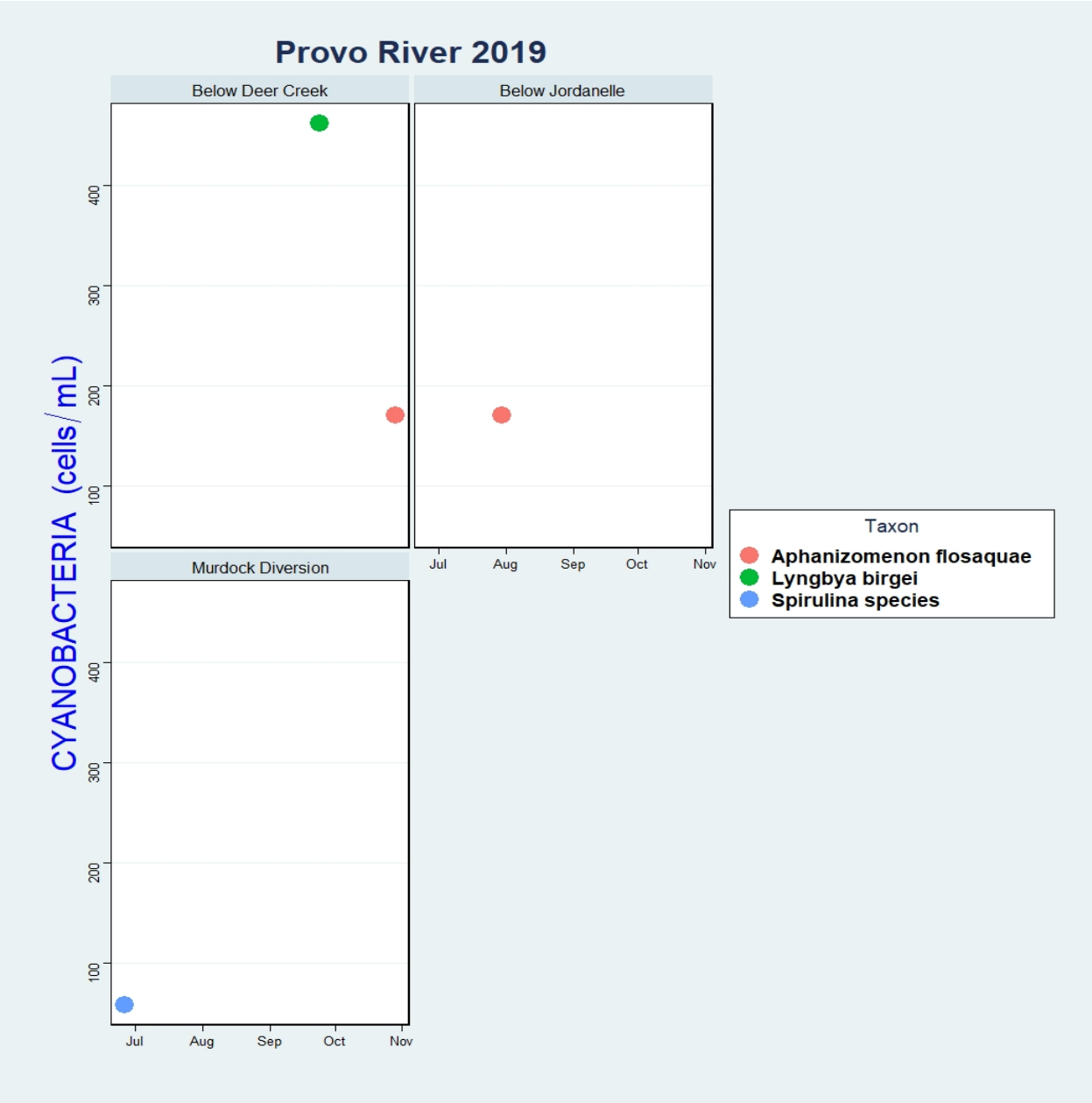

Figure 17: Cyanobacteria cell counts from the Provo River in 2019.

Nutrients

Nutrients were measured from a surface sample collected from the thalweg. The total phosphorus concentration regularly exceeds the State water quality pollution standard with a peak value of 0.13 mg/L in May 2016 (see figure 18). The nitrate concentrations have remained well below the State standard (see figure 19).

Figure 18

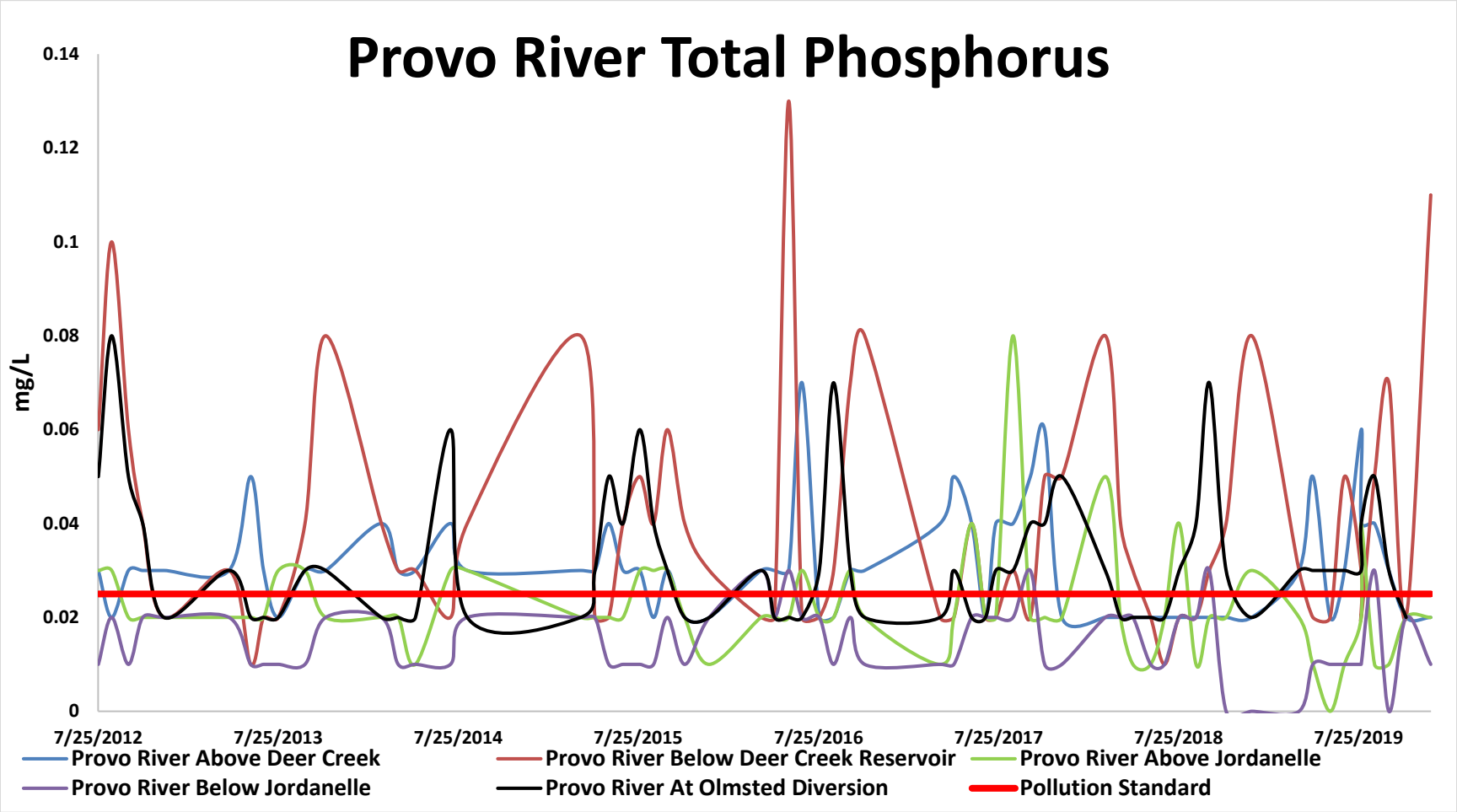

Figure 18: Total Phosphorus concentrations in the Provo River. The water quality pollution standard is often exceeded.

Figure 19

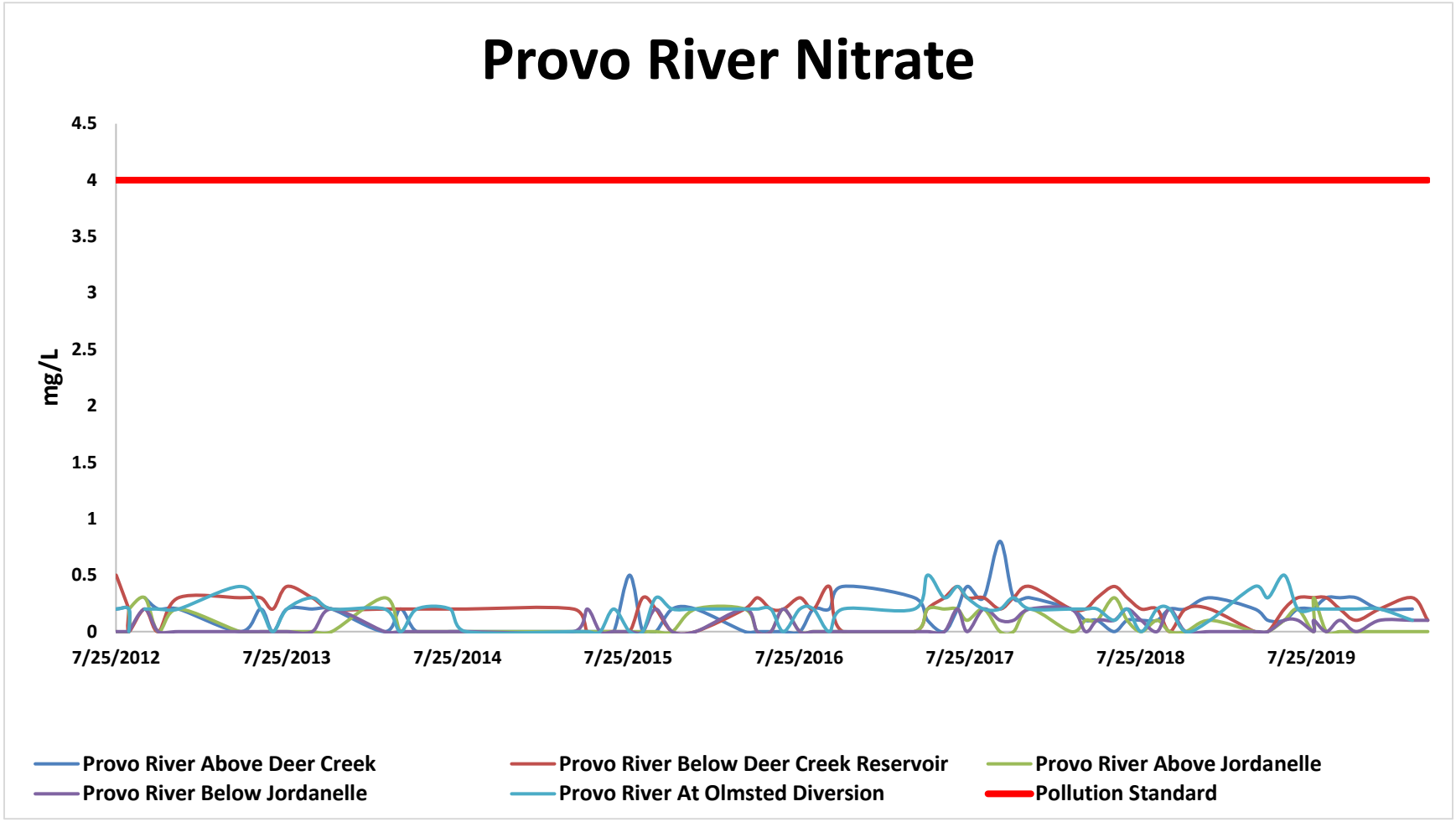

Figure 19: Nitrate concentrations in the Provo River. Nitrate levels are well below the 4 mg/L threshold set by the Division of Water Quality.

Total Organic Carbon

Total Organic Carbon (TOC) levels in the Provo River have been relatively low over the last eight years (see figure 20).

Figure 20

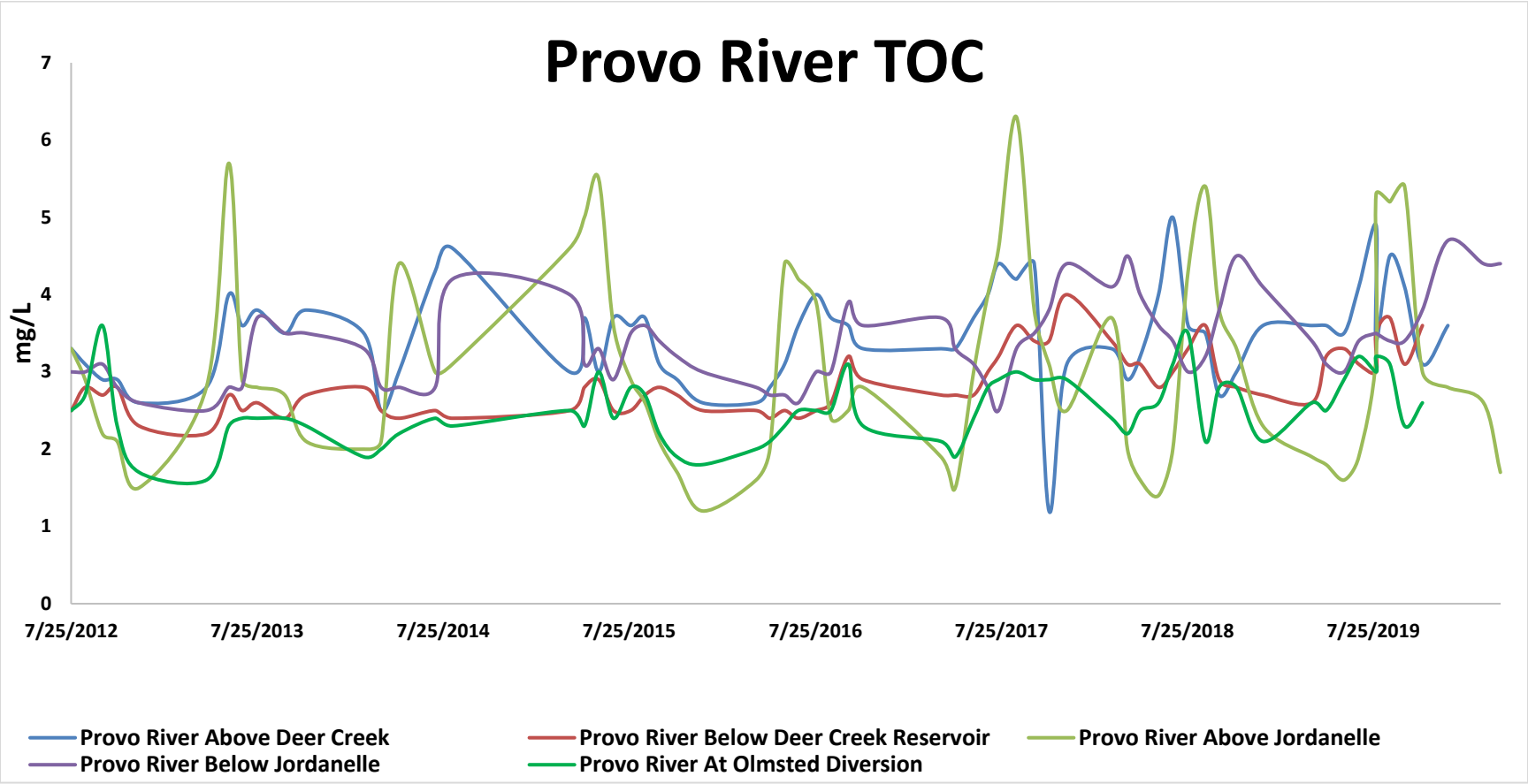

Figure 20: Total Organic Carbon concentrations in the Provo River

SUMMARY

The water quality in the Provo River Watershed was monitored and analyzed for nitrate, total phosphorus, phytoplankton, and total organic carbon. A trophic state index was also calculated using chlorophyll *a* and total secchi disk data.

Over the last eight years Jordanelle has experienced low levels of nitrate and phosphorus. During that timeframe nitrate never exceeded the State pollution standard, 4 mg/L, and total phosphorus exceeded the standard, 0.025 mg/L, only once in October 2016. The cyanobacteria levels in 2019 were also very low with a maximum cell count of 196 cells/mL. Total Organic Carbon levels in Jordanelle, like the rest of the watershed, remained low. The Trophic State Index suggests that Jordanelle is currently considered mesotrophic.

Deer Creek and the Provo River have also experienced low levels of nitrate during the past eight years. However, the total phosphorus concentrations frequently exceed the state standard of 0.025 mg/L. The maximum total phosphorus value in Deer Creek was 0.067 mg/L in August 2012 and the maximum value in the Provo River was 0.13 mg/L in May of 2016. While these values are higher than the standard it is important to note that when compared to historical data of the late 1970's and 1980's (data not shown) they are lower and the trophic status of Deer Creek has improved from eutrophic to mesotrophic. Nevertheless, these elevated values demonstrate the importance of monitoring these water bodies and continuing the ongoing efforts to work with local, state, and federal stakeholders to improve water quality in the Provo River watershed.

During 2019 phytoplankton levels in Deer Creek were usually dominated by diatoms and green algae. In September, the cyanobacteria dominated the water column and peaked at 6006 cells/mL. While this value is high it is still below the WHO guideline of 20,000 cells/mL. The Provo River phytoplankton community was almost always dominated by diatoms. There were four times during 2019 when cyanobacteria were found at the sample locations. The highest value, 462 cells/mL, occurred in September, Below Deer Creek.

Overall, the water quality within the Provo River Watershed continues to be better than during the 1970's, 1980's and early 1990's. With that in mind it is imperative to continue to be vigilant in monitoring in and remaining steadfast in our efforts to improve water quality.