

Current Report

Methods

Continuous data were collected for the water quality shown in Table 2. Each of the 15 monitoring stations collected continuous data for water temperature (WT), pH, dissolved oxygen (DO), surface-specific conductance (SpC), chlorophyll a fluorescence, and turbidity. Additionally, sensors were installed at the Antioch, Mallard Island, and Martinez stations in the 1990's to monitor bottom SpC. Along with river stage data measured at the Mallard Island and Martinez stations, these bottom SpC measurements determine compliance with the mandated salinity standard (also known as X2) set by the State Water Resources Control Board (SWRCB) in the 1995 Bay-Delta Plan. Except for bottom-specific conductance, all water samples were collected 1-meter below the water surface using a float-mounted YSI EXO2 multi-parameter water quality sonde. In contrast, bottom-specific conductance was measured at 1.5 meters above the channel bottom using a YSI EXO1 sonde. Water quality data was recorded at 15-minute intervals.

Table 2: Parameters sampled by Continuous EMP

Parameter	Units	Frequency
Water Temperature	°C	15 minute instantaneous
Specific Conductance	µS/cm	15 minute instantaneous
DO	mg/L	15 minute instantaneous
pH	unitless	15 minute instantaneous
Turbidity	FNU	15 minute instantaneous
Fluorescence	µg/L	15 minute instantaneous

QA Status

Quality assurance and control measures were applied according to CEMP's Quality Assurance Project Plan (QAPP) (Appendix A). Only data validated as "Good Data" according to Section 22 of the QAPP were analyzed for this report.

Regions

The daily averages of the continuous 15-minute data collected for air and water temperature, pH, DO, surface and bottom SpC, chlorophyll a fluorescence, and turbidity for calendar year 2021 are shown in Figures 3 to 34. The range of monthly DO values at the Stockton station is shown below.

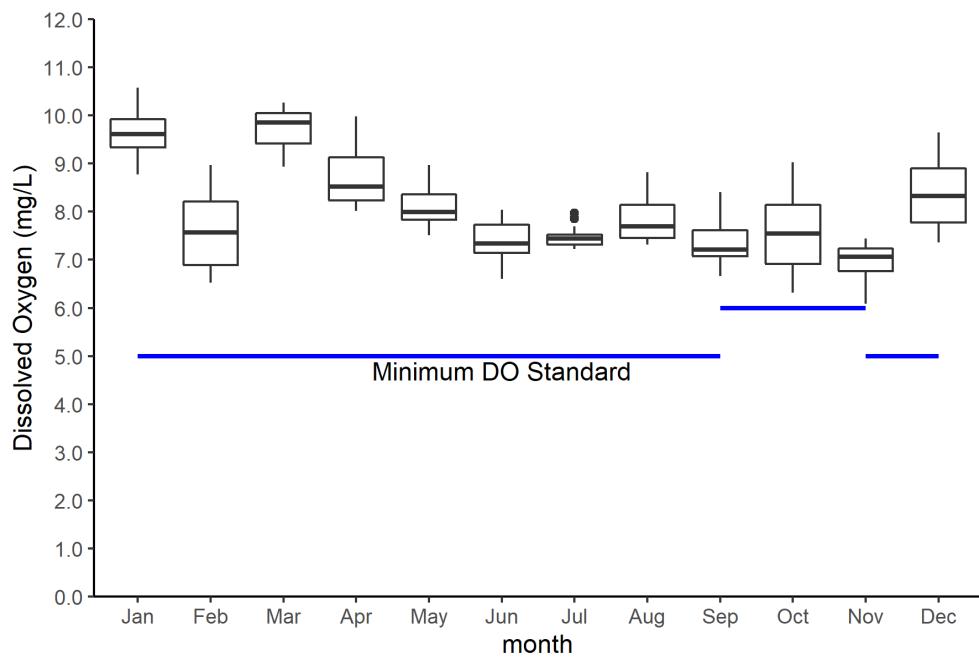


Figure 2: Range of daily dissolved oxygen Rough and Ready Isl. (P8), 2021

Northern Interior Delta

The Northern Interior Delta stations had surface-specific conductance values that ranged from 126 µS/cm (C3A in June) to 1414 µS/cm (D24A in June). Surface turbidity values ranged from 1.05 NTU (C3A in October) to 79.22 NTU (C3A in October). Surface water temperature values ranged from 7.83 °C (C3A in December) to 26.31°C (C3A in July). Surface dissolved oxygen

values ranged from 6.16 mg/L (D24A in November) to 11.07 mg/L (C3A in January). Surface pH values ranged from 7.05 (C3A in October) to 8.12 (D24A in September). Surface fluorescence values ranged from 0.55 µg/L (D24A in November) to 6.57 µg/L (C3A in December).

Table 3: Summary statistics for Northern Interior Delta, 2021

Statistic	Specific Conductance ($\mu\text{s}/\text{cm}$)	Turbidity (FNU)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Fluorescence ($\mu\text{g}/\text{L}$)
	Surface	Surface	Surface	Surface	Surface	Surface
MIN	126	1.05	7.83	6.16	7.05	0.55
MAX	1414	79.22	26.31	11.07	8.12	6.57
AVERAGE	299	8.05	17.3	8.96	7.72	1.63

Southern Interior Delta

The Southern Interior Delta stations had surface-specific conductance values that ranged from 74 µS/cm (C10A in July) to 1242 µS/cm (P8A in March). Surface turbidity values ranged from 0.16 NTU (C7A in October) to 86.29 NTU (C10A in January). Surface water temperature values ranged from 8.41 °C (C10A in December) to 26.66 °C (P8A in July). Surface dissolved oxygen values ranged from 6.09 mg/L (P8A in November) to 13.10 mg/L (C7A in April). Surface pH values ranged from 7.19 (P8A in October) to 8.52 (C7A in April). Surface fluorescence values ranged from 0.66 µg/L (C7A in December) to 47.77 µg/L (C7A in April).

Table 4: Summary statistics for Southern Interior Delta, 2021

Statistic	Specific Conductance ($\mu\text{s}/\text{cm}$)	Turbidity (FNU)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Fluorescence ($\mu\text{g}/\text{L}$)
	Surface	Surface	Surface	Surface	Surface	Surface
MIN	74	0.16	8.41	6.09	7.19	0.66
MAX	1242	86.29	26.66	13.10	8.52	47.77
AVERAGE	554	6.04	17.56	8.95	7.68	4.86

Central Interior Delta

The Central Interior Delta stations had surface-specific conductance values that ranged from 314 µS/cm (D16A in December) to 2370 µS/cm (D16A in October). Surface turbidity values ranged from 0.11 NTU (D19A in September) to 148.9 NTU (D19A in January). Surface water temperature values ranged from 8.37 °C (D19A in January) to 25.36 °C (D19A in July). Surface dissolved oxygen values ranged from 6.80 mg/L (D29 in November) to 15.81 mg/L (D19A in October). Surface pH values ranged from 7.23 (D29 in November) to 10.42 (D19A in September). Surface fluorescence values ranged from 0.38 µg/L (D19A in September) to 25.68 µg/L (D29 in May).

Table 5: Summary statistics for Central Interior Delta, 2021

Statistic	Specific Conductance (µS/cm)	Turbidity (FNU)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Fluorescence (µg/L)
	Surface	Surface	Surface	Surface	Surface	Surface
MIN	314	0.11	8.37	6.80	7.23	0.38
MAX	2369	148.90	25.36	15.81	10.42	25.68
AVERAGE	699	6.37	17.11	9.46	8.05	2.94

Confluence

The Confluence stations had surface-specific conductance values that ranged from 242 µS/cm (D22A in December) to 18400 µS/cm (D10A in October). Bottom-specific conductance values ranged from 506 µS/cm (D12A in December) to 19122 µS/cm (D10A in October). Surface turbidity values ranged from 4.57 NTU (D10A in October) to 32.65 NTU (D10A in June). Surface water temperature values ranged from 8.55 °C (D12A in January) to 22.52 °C (D22A in August). Bottom water temperature values ranged from 8.78 °C (D22A in December) to 22.47 °C (D12A in June). Surface dissolved oxygen values ranged from 6.44 mg/L (D22A in November) to 10.98 mg/L (D22A in January). Surface pH values ranged from 7.30 (D22A in November) to 8.07 (D12A in December). Surface fluorescence values ranged from 0.67 µg/L (D22A in October) to 11.92 µg/L (D10A in June).

Table 6: Rating criteria for Confluence, 2021

Statistic	Specific Conductance - S ($\mu\text{s}/\text{cm}$)	Specific Conductance - B ($\mu\text{s}/\text{cm}$)	Turbidity (FNU)	Water Temperature - S ($^{\circ}\text{C}$)	Water Temperature - B ($^{\circ}\text{C}$)	Dissolved Oxygen (mg/L)	Site
	Surface	Bottom	Surface	Surface	Bottom	Surface	Si
MIN	242	506	4.57	8.55	8.78	6.44	
MAX	18400	19122	32.65	22.52	22.47	10.98	
AVERAGE	6441	8172	13.67	16.51	16.49	8.14	

Grizzly/Suisun Bay

The Grizzly Suisun Bay stations had surface-specific conductance values that ranged from 770 $\mu\text{S}/\text{cm}$ (D9A in December) to 33077 $\mu\text{S}/\text{cm}$ (D6A in June). Bottom-specific conductance values ranged from 12441 $\mu\text{S}/\text{cm}$ (D6A in December) to 34768 $\mu\text{S}/\text{cm}$ (D6A in June). Surface turbidity values ranged from 2.22 NTU (D7A in October) to 170.18 NTU (D7A in January). Surface water temperature values ranged from 8.32 $^{\circ}\text{C}$ (D7A in December) to 22.52 $^{\circ}\text{C}$ (D7A in June). Bottom water temperature values ranged from 9.38 $^{\circ}\text{C}$ (D6A in December) to 20.77 $^{\circ}\text{C}$ (D6A in June). Surface dissolved oxygen values ranged from 7.50 mg/L (D6A in August) to 10.99 mg/L (D7A in January). Surface pH values ranged from 7.54 (D9A in November) to 8.17 (D7A in March). Surface fluorescence values ranged from 0.25 $\mu\text{g}/\text{L}$ (D6A in October) to 21.61 $\mu\text{g}/\text{L}$ (D7A in March).

Table 7: Rating criteria for Grizzly/Suisun Bay, 2021

Statistic	Specific Conductance - S ($\mu\text{s}/\text{cm}$)	Specific Conductance - B ($\mu\text{s}/\text{cm}$)	Turbidity (NTU)	Water Temperature - S ($^{\circ}\text{C}$)	Water Temperature - B ($^{\circ}\text{C}$)	Dissolved Oxygen (mg/L)	Site
	Surface	Bottom	Surface	Surface	Bottom	Surface	Si
MIN	770	12441	2.22	8.32	9.38	7.5	
MAX	33977	34768	170.18	22.52	20.77	10.99	
AVERAGE	18506	28889	27.72	16.18	16.12	8.89	

Parameters

Water Temperature

Average daily water temperatures in the estuary ranged from 7.83 °C to 26.66°C, with the lower values occurring in the Northern Interior Delta location and the higher values found in the Southern Interior Delta stations. Average daily water temperatures at the Northern Interior Delta stations were typically lower than those observed at the Southern Interior Delta stations. The most significant divergence occurred from July through September at the Southern Interior Delta locations.

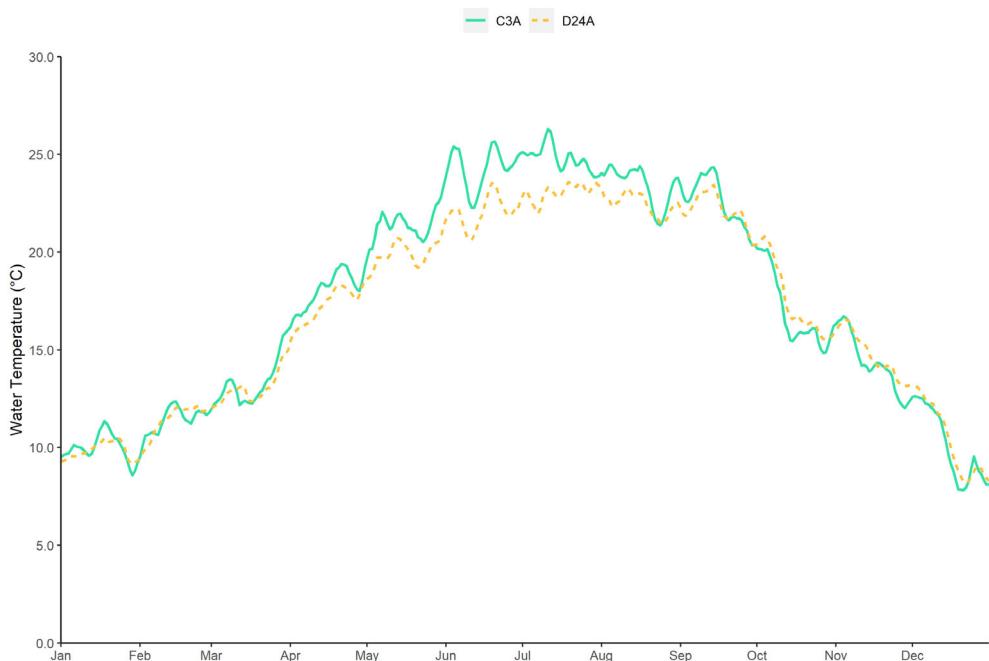


Figure 3: Average daily water temperature in the Northern Interior Delta, 2021



Figure 4: Average daily water temperature in the Southern Interior Delta, 2021

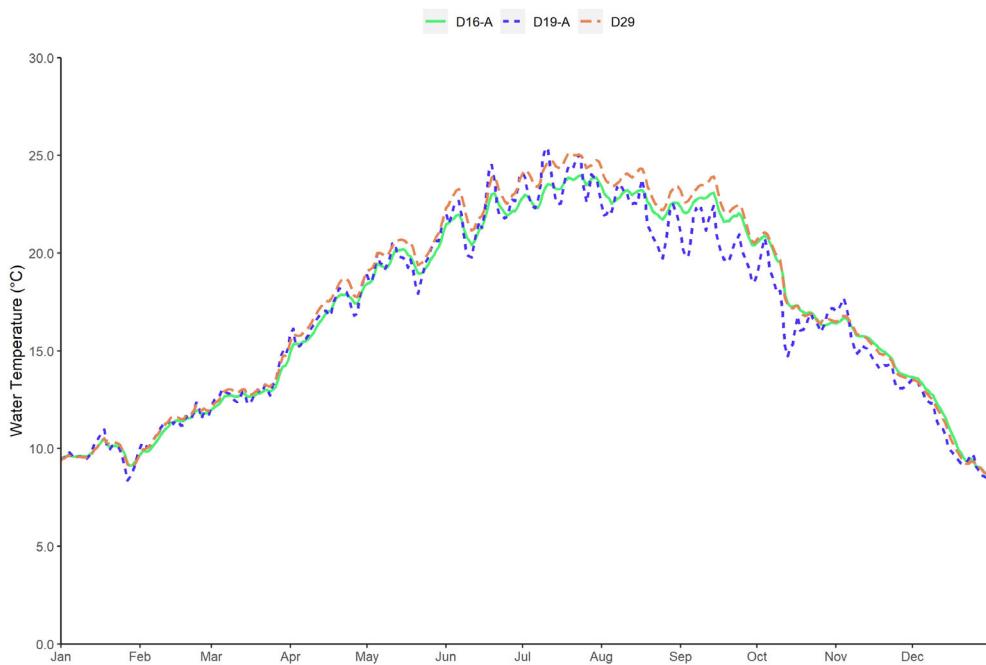


Figure 5: Average daily water temperature in the Central Delta, 2021



Figure 6: Average daily water temperature in the Confluence, 2021



Figure 7: Average daily water temperature in the Grizzly/Suisun Bays, 2021

Specific Conductance

Average daily surface-specific conductance for the estuary ranged from 74 $\mu\text{S}/\text{cm}$ to 33,077 $\mu\text{S}/\text{cm}$. The lower values were observed at the Northern Interior Delta stations and the higher at the more tidally influenced Grizzly/Suisun Bay locations (Figure 3e). In response to extreme precipitation and runoff events, most stations showed significant decreases in specific conductance values in October and December.

Bottom-specific conductance measured in 2021 at D12A, D10A, and D6A stations exhibited seasonal patterns and ranges similar to the surface-specific conductance values.

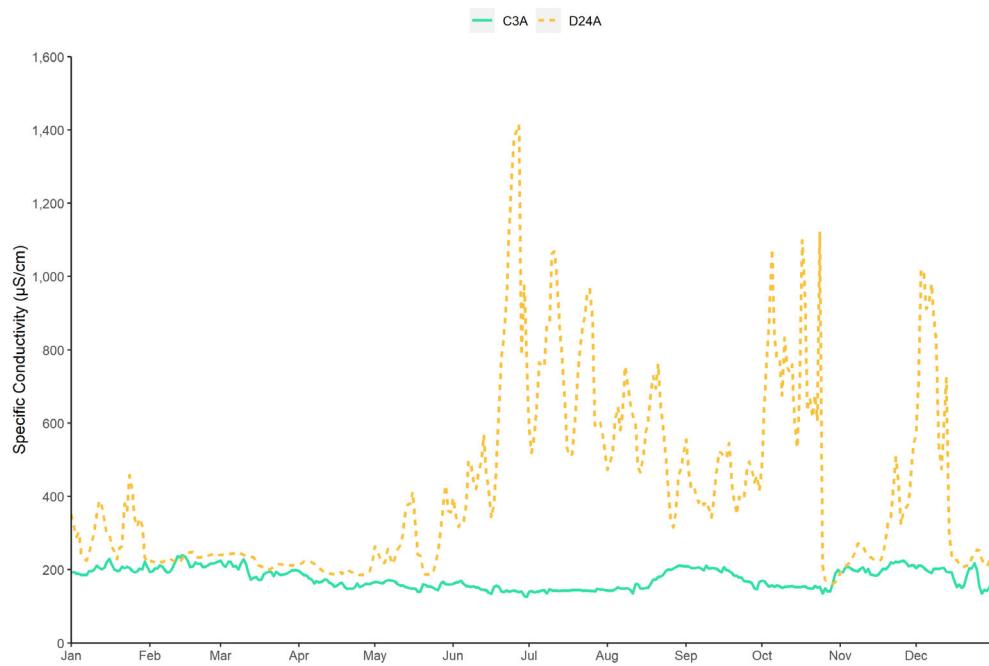


Figure 8: Average daily specific conductance in the Northern Interior Delta, 2021

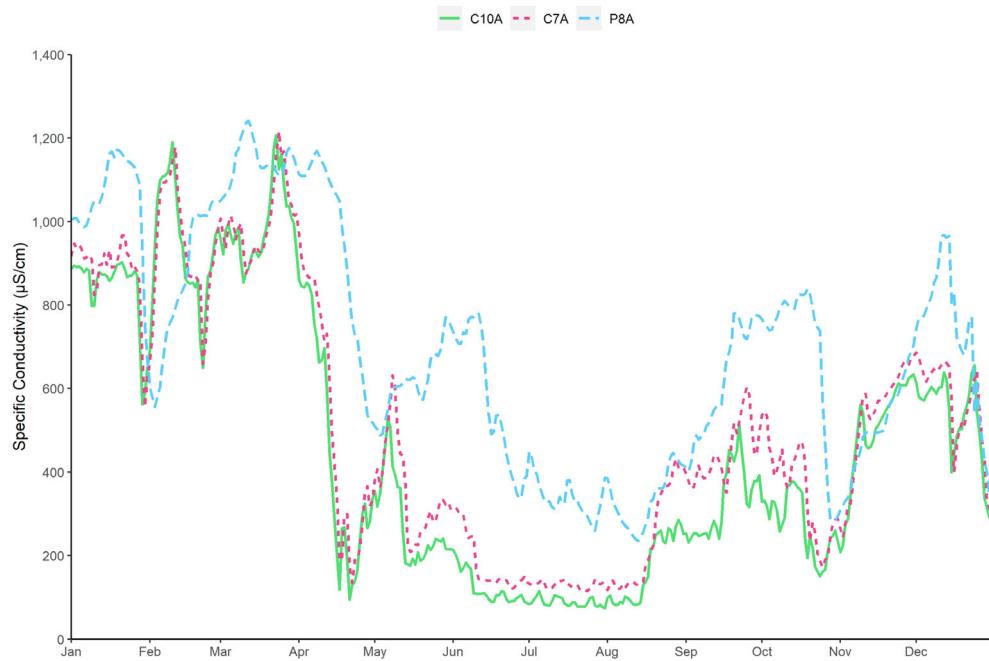


Figure 9: Average daily specific conductance in the Southern Interior Delta, 2021

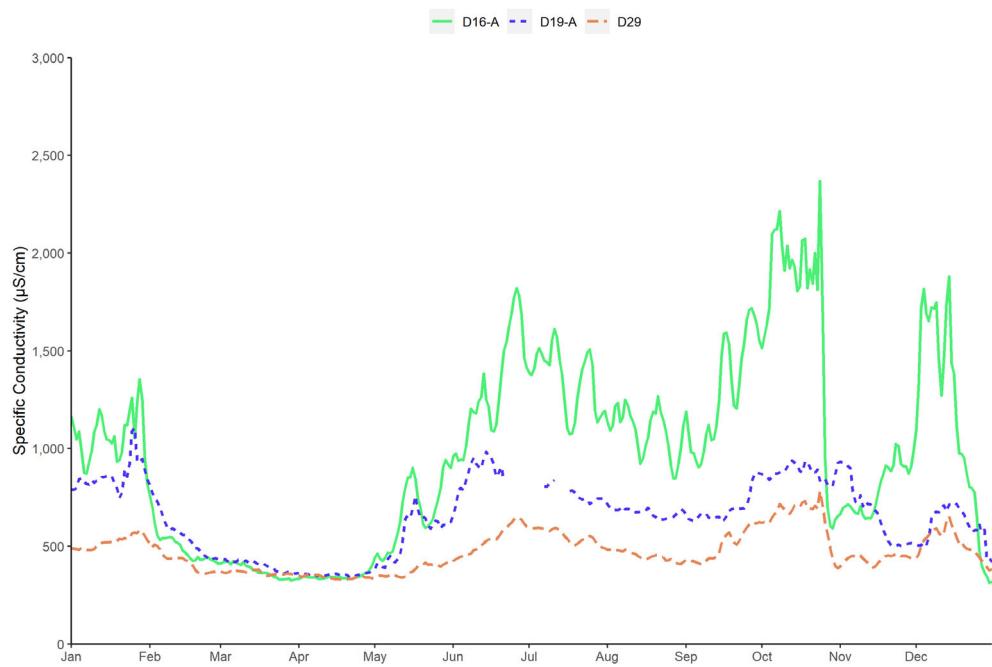


Figure 10: Average daily specific conductance in the Central Delta, 2021

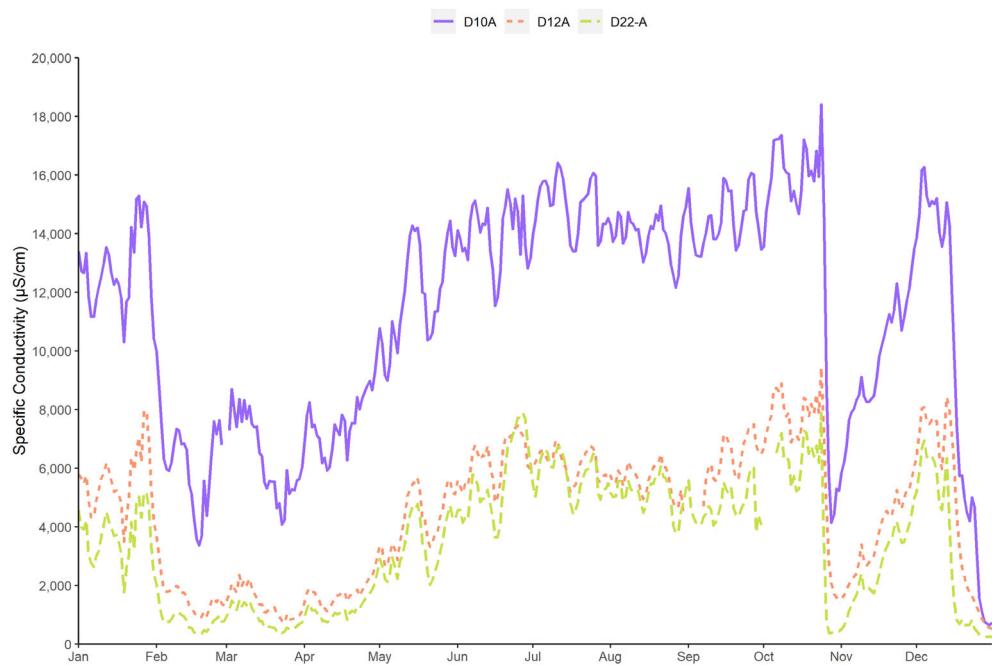


Figure 11: Average daily specific conductance in the Confluence, 2021

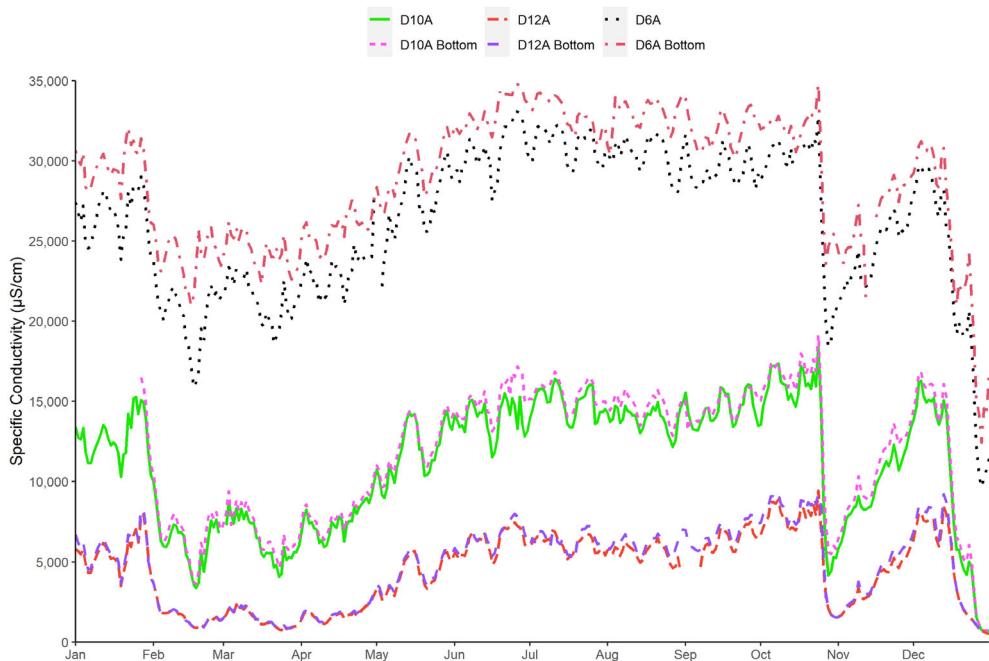


Figure 12: Average daily specific conductance in the Grizzly/Suisun Bays, 2021

Dissolved Oxygen

Average daily DO values in the estuary ranged from 6.09 mg/L to 15.81 mg/L (Figures 4a to 4e). The most significant variability was observed at the Southern Interior Delta stations. All compliance monitoring stations recorded daily averages above the 5.0 mg/L standard set by the CVRWQCB in the Basin Plan (CVRWQCB, 1998). The monthly average DO levels at the Stockton station did not fall below the 5.0 mg/L standard set by the CVRWQCB (1998). In addition, the monthly average DO levels did not drop below the 6.0 mg/L standard (SWRCB, 1995) for the passage of fall-run Chinook salmon through the ship channel for the September through November control period.



Figure 13: Average daily dissolved oxygen in the Northern Interior Delta, 2021

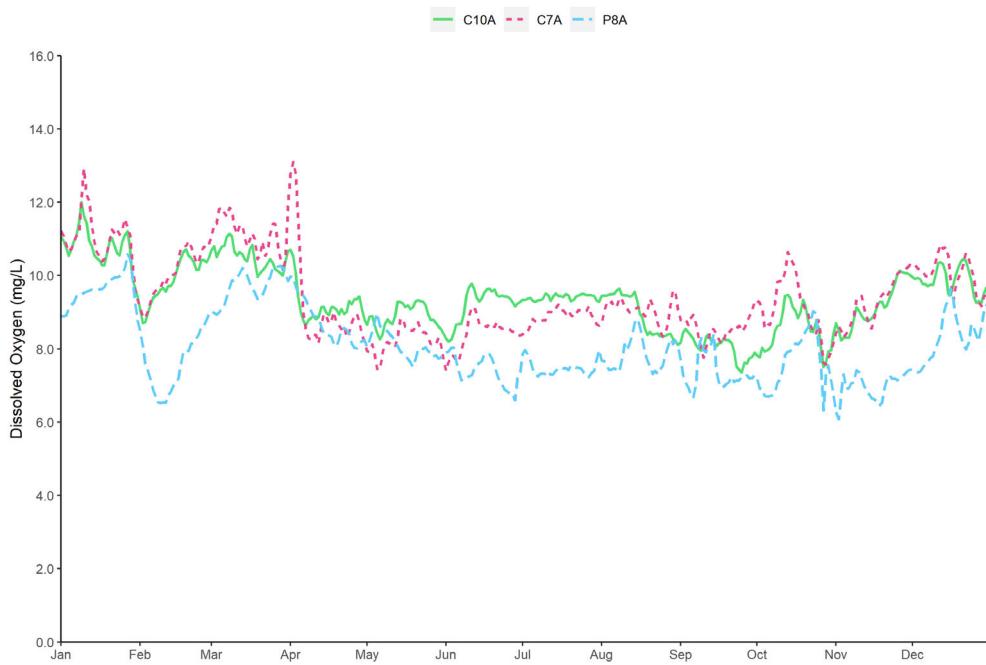


Figure 14: Average daily dissolved oxygen in the Southern Interior Delta, 2021

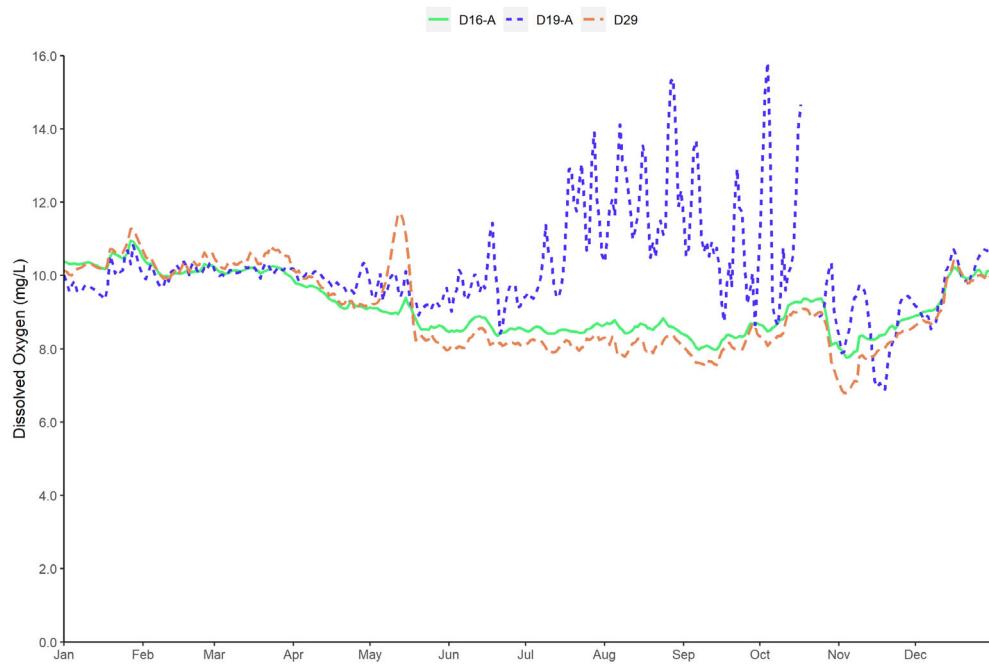


Figure 15: Average daily dissolved oxygen in the Central Delta, 2021



Figure 16: Average daily dissolved oxygen in the Confluence, 2021

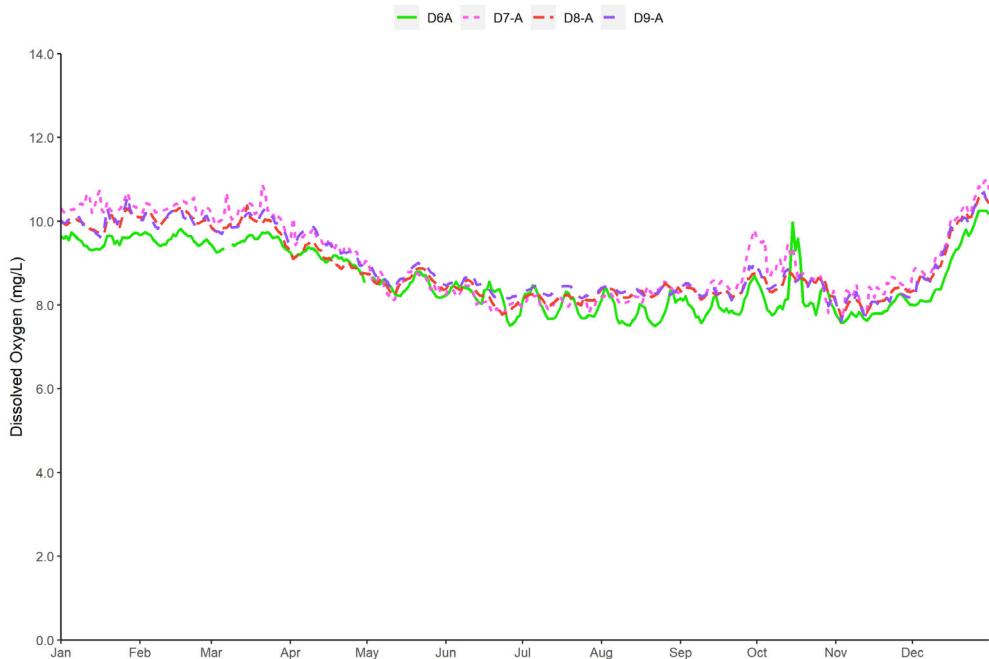


Figure 17: Average daily dissolved oxygen in the Grizzly/Suisun Bays, 2021

pH

Average daily pH levels at all stations in the estuary ranged from 7.05 to 10.42 (Figures 5a to 5e). The Southern Interior Delta stations observed significant increases in average daily pH from June 2021 to September 2021 (Figure 5b). In addition, the Central Delta station D19A showed an increase in pH values from June to October (Figure 5c).

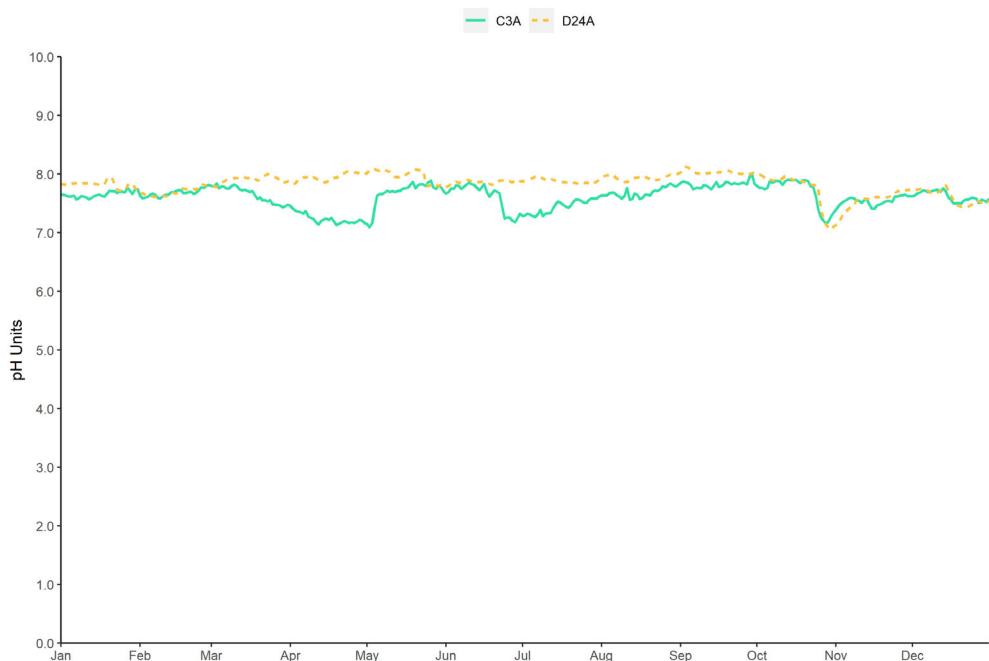


Figure 18: Average daily pH in the Northern Interior Delta, 2021



Figure 19: Average daily pH in the Southern Interior Delta, 2021

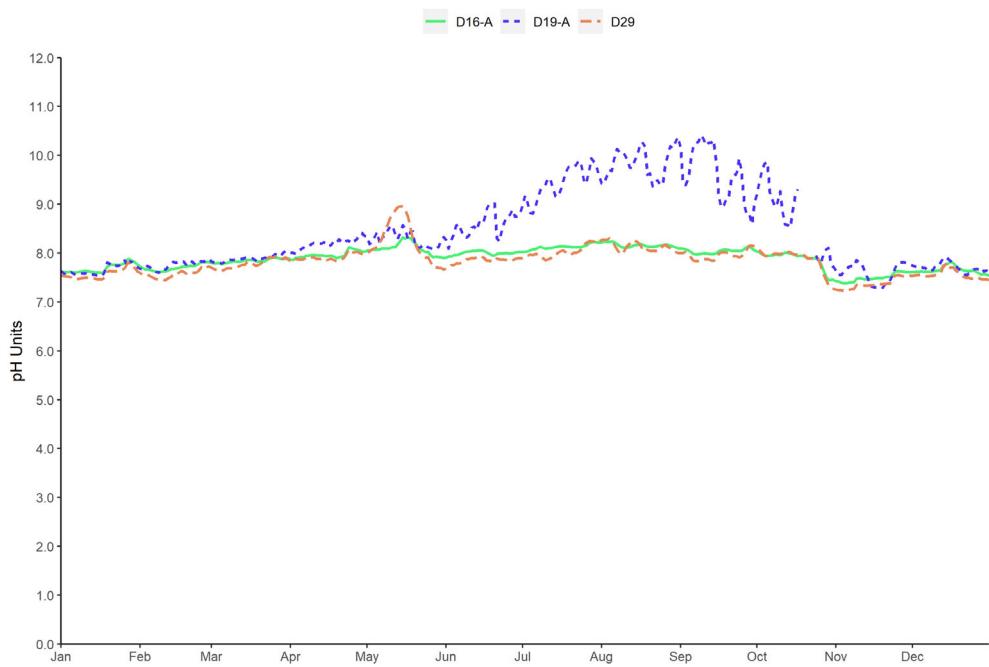


Figure 20: Average daily pH in the Central Delta, 2021

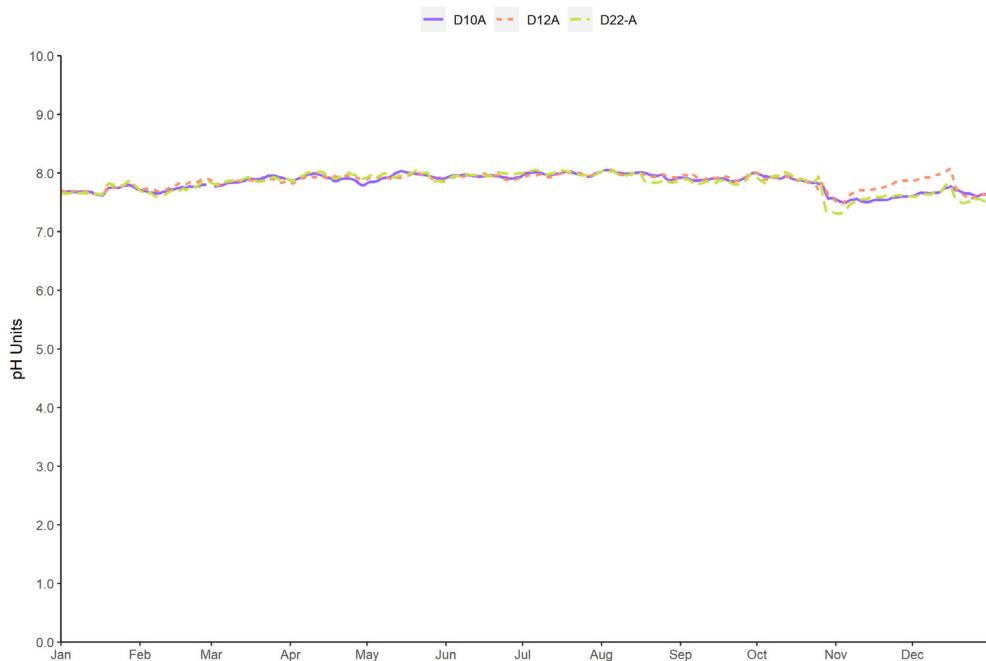


Figure 21: Average daily pH in the Confluence, 2021

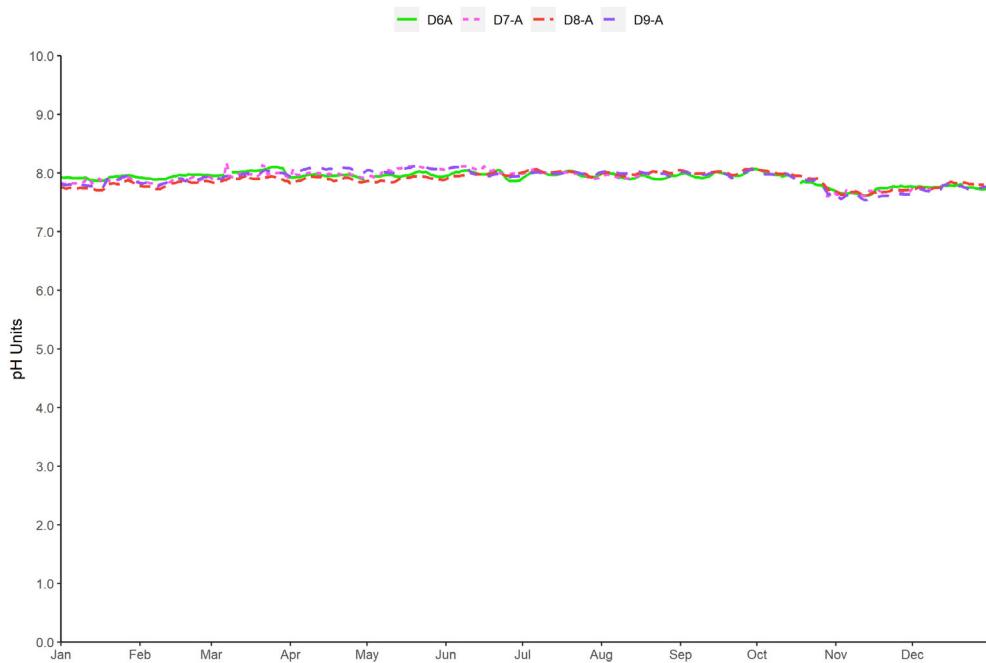


Figure 22: Average daily pH in the Grizzly/Suisun Bays, 2021

Turbidity

Average daily turbidity levels at all stations in the estuary ranged from 0.11 NTU to 170.2 NTU (Figures 6a to 6e). The Southern Interior Delta stations showed a significant increase in turbidity in January and February, peaking at 86.29 NTU (Figure 6b). In addition, all Northern Interior Delta stations showed a substantial spike in turbidity values in late October and December. (Figure 6a).

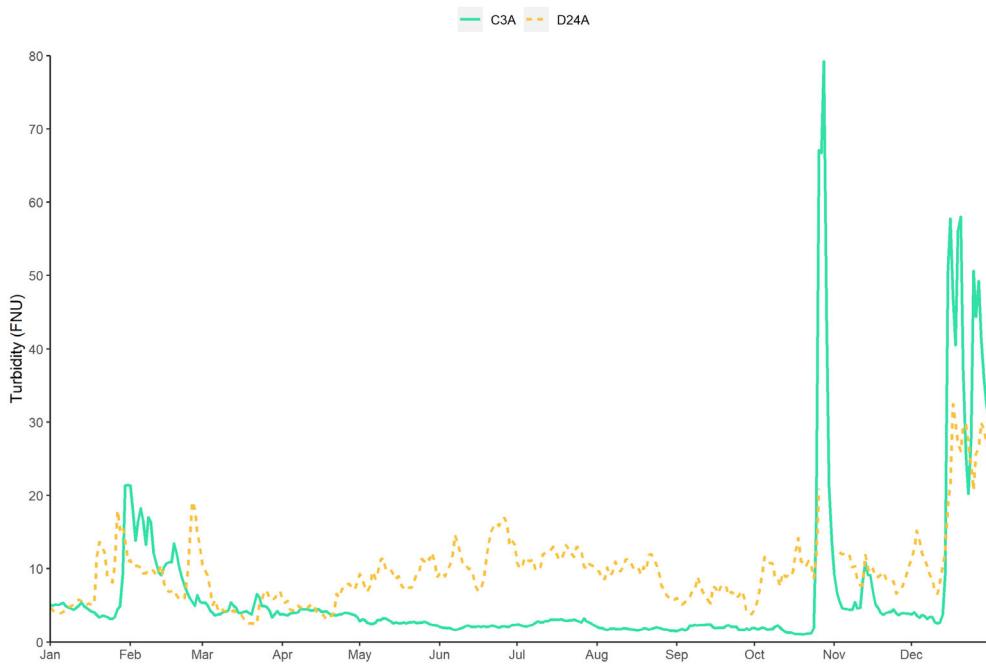


Figure 23: Average daily turbidity in the Northern Interior Delta, 2021

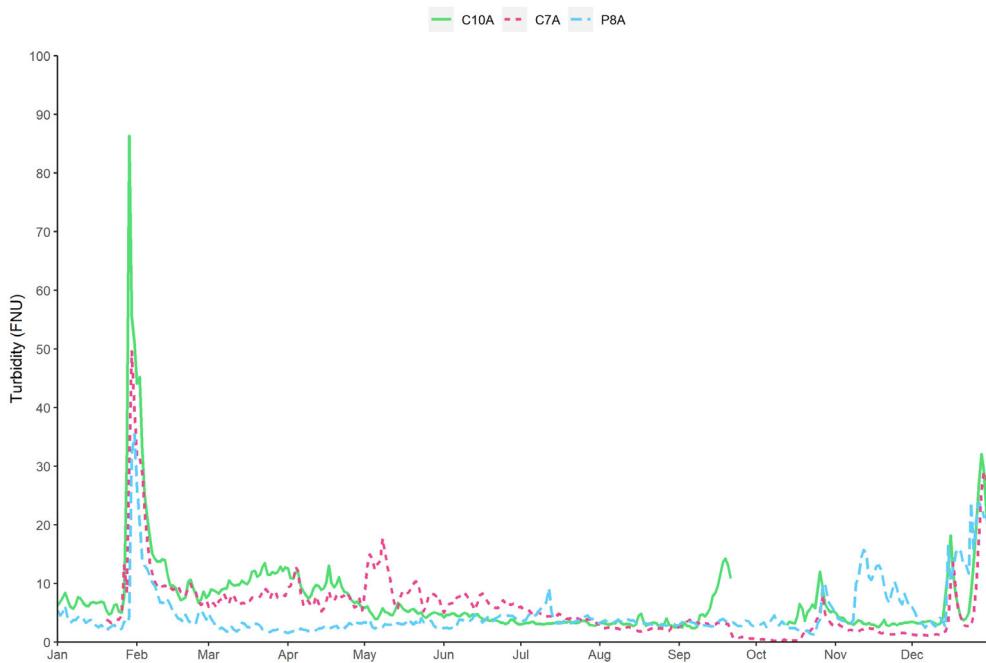


Figure 24: Average daily turbidity in the Southern Interior Delta, 2021

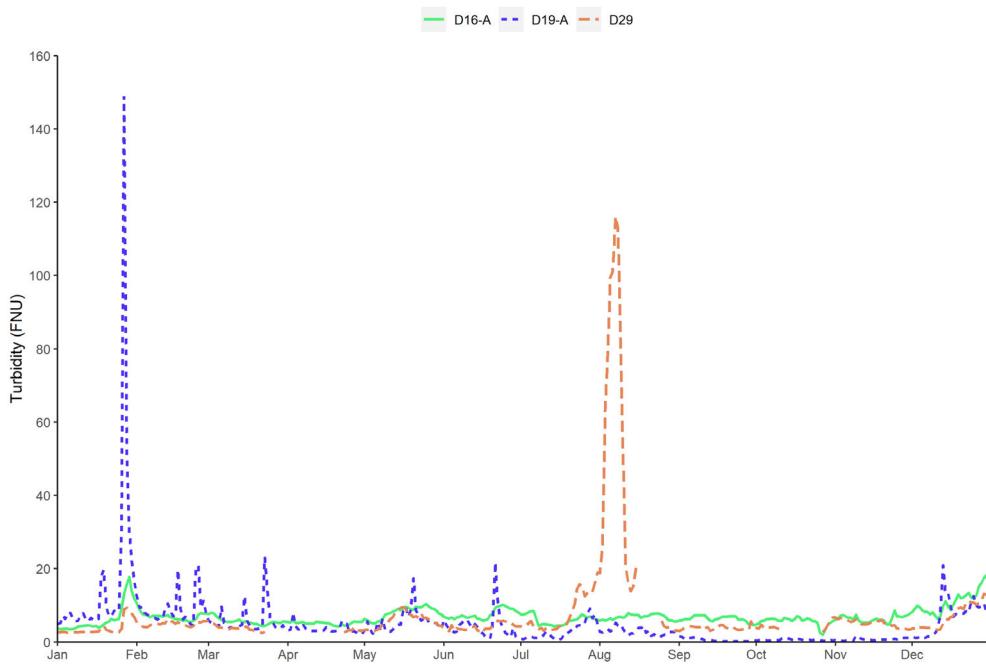


Figure 25: Average daily turbidity in the Central Delta, 2021

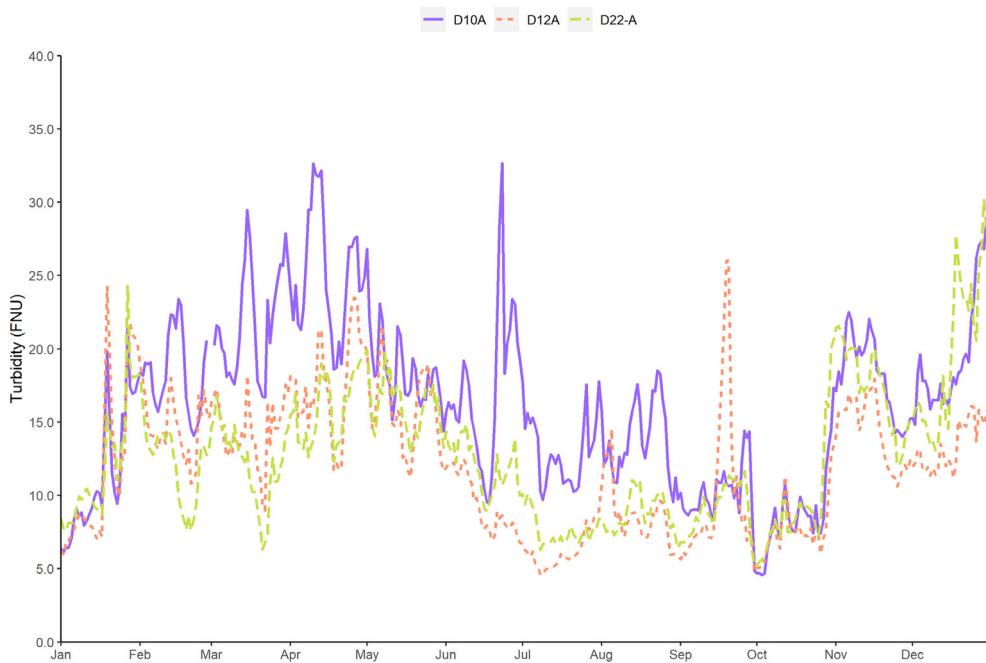


Figure 26: Average daily turbidity in the Confluence, 2021

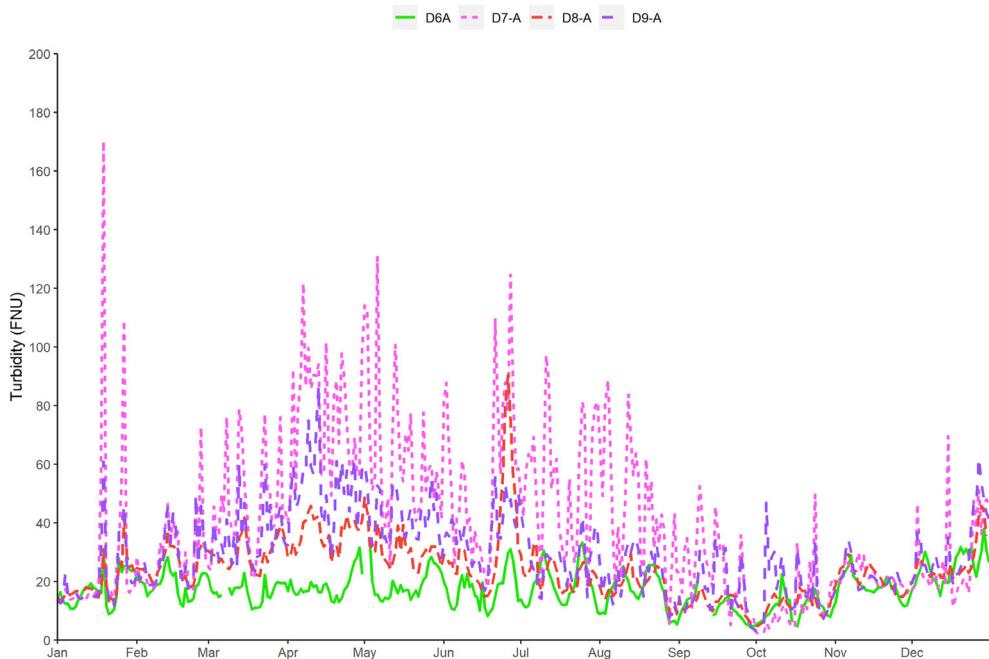


Figure 27: Average daily turbidity in the Grizzly/Suisun Bays, 2021

Chlorophyll a Fluorescence

Average daily chlorophyll a fluorescence recorded at all stations ranged from 0.25 µg/L to 47.77 µg/L. Daily fluorescence averages at Southern Interior Delta stations exhibited higher values from January to April, except for station P8A (Figure 7b).

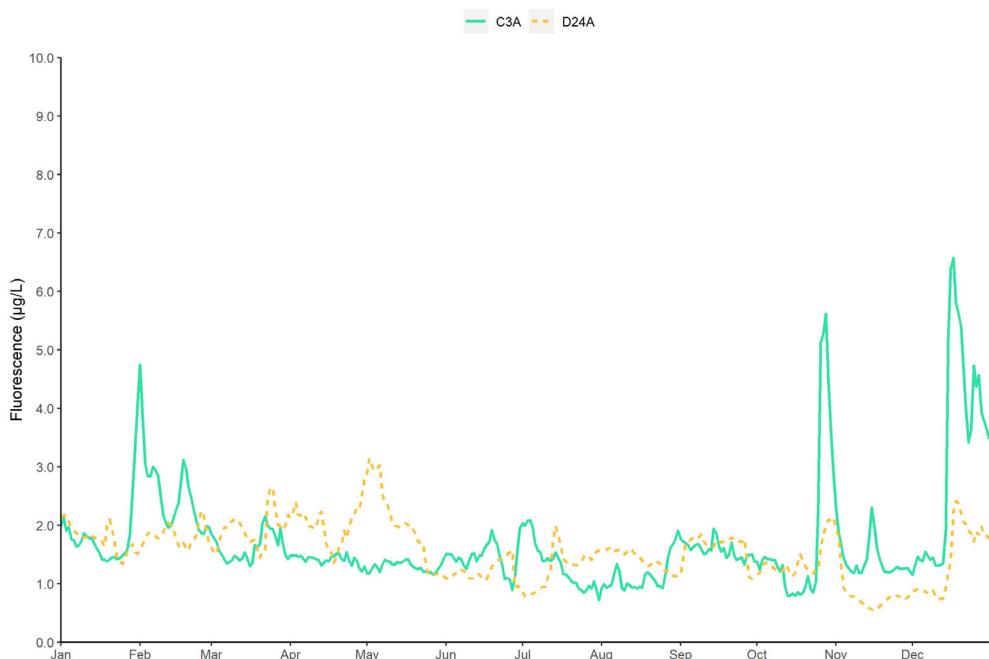
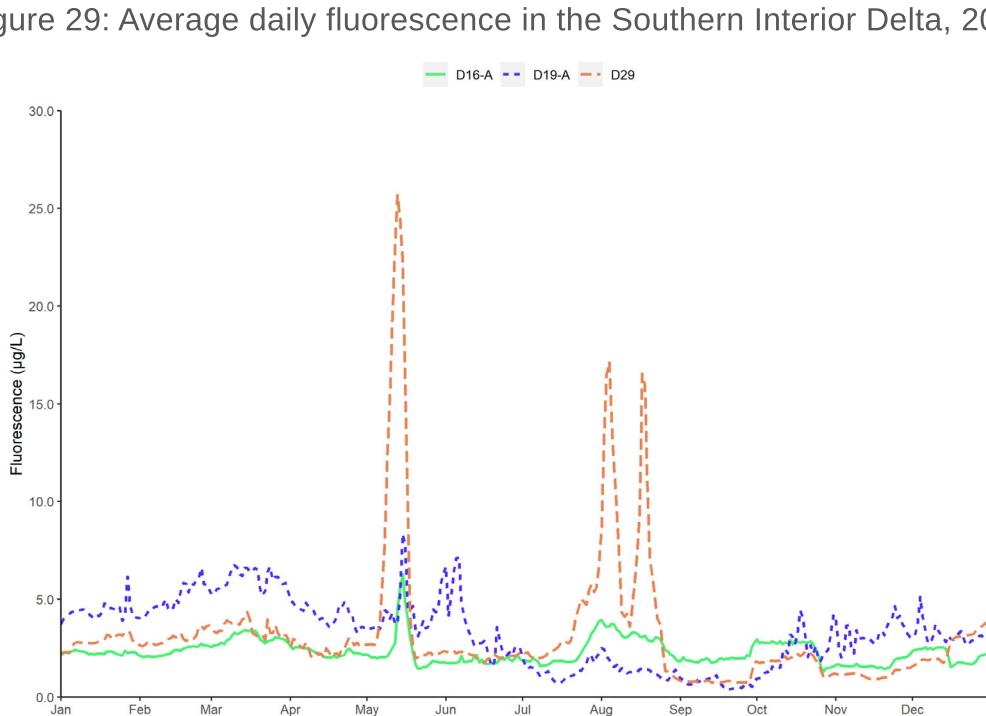
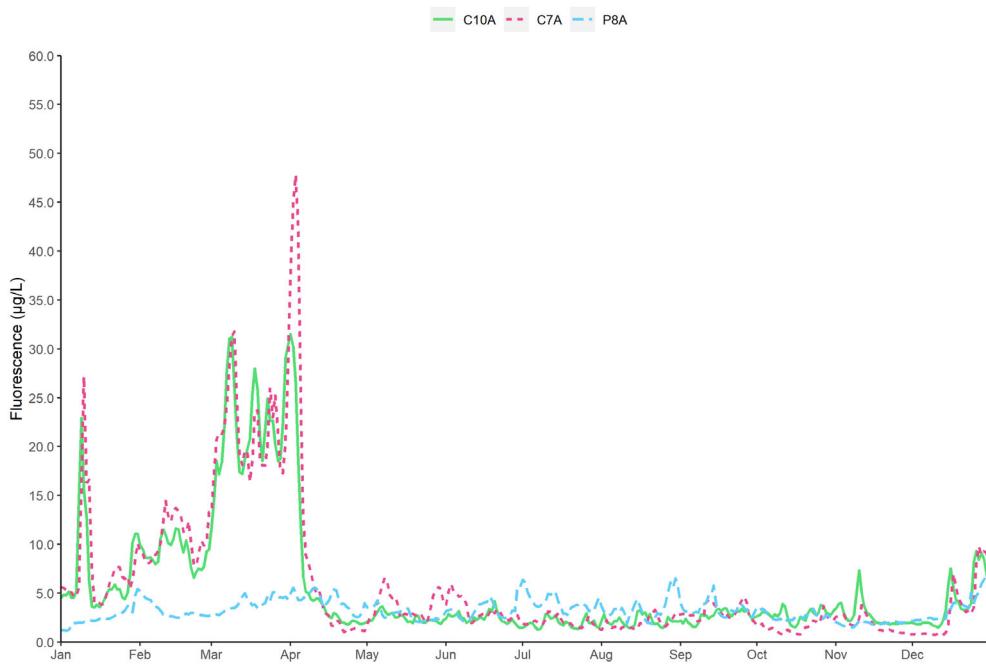


Figure 28: Average daily fluorescence in the Northern Interior Delta, 2021



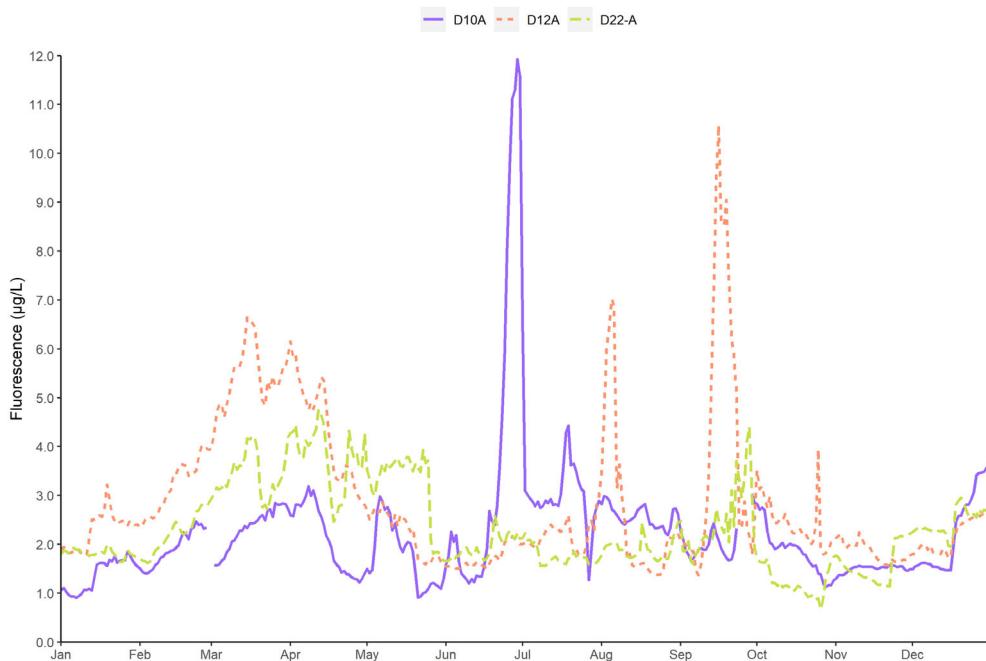


Figure 31: Average daily fluorescence in the Confluence, 2021

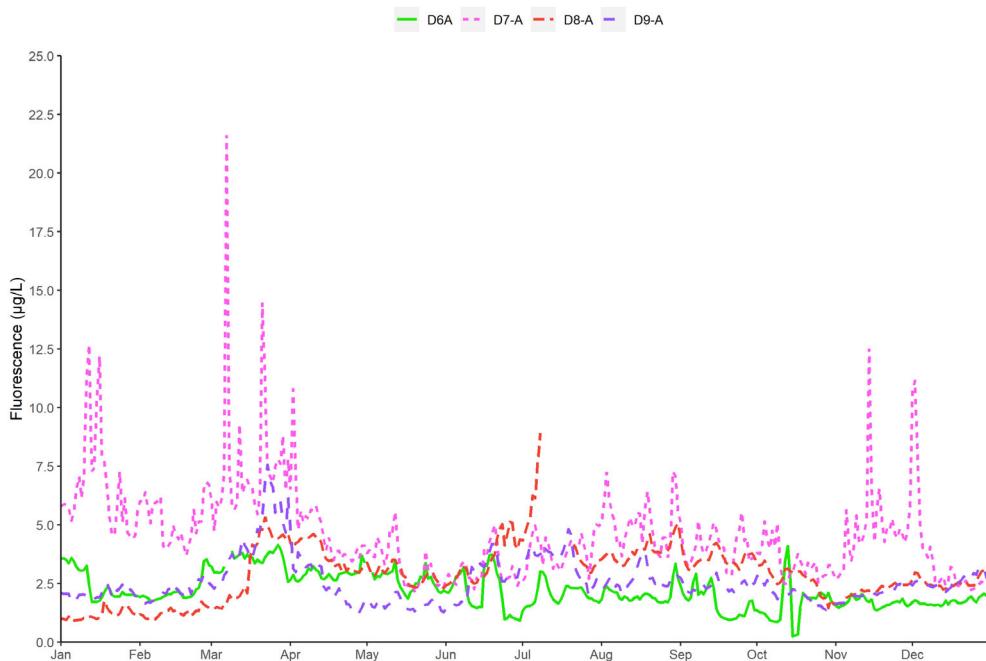


Figure 32: Average daily fluorescence in the Grizzly/Suisun Bays, 2021

References

[CVRWQCB] Central Valley Regional Water Quality Control Board. (1998). Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, the Sacramento River Basin, and San Joaquin River Basin [Basin Plan] (4th ed.).

[SWRCB] State Water Resources Control Board. (1995). Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Estuary [Bay-Delta Plan] (Adopted May 22, 1995, pursuant to Water Right Order 95-1). Sacramento, CA.

[SWRCB] State Water Resources Control Board. (1999). Water Rights Decision 1641 for the Sacramento-San Joaquin Delta and Suisun Marsh (Adopted December 29, 1999, Revised in Accordance with order WR2000-02 March 15, 2000). Sacramento, CA.