Estero Bay Aquatic Preserve

SEACAR Water Quality Analysis

Last compiled on 30 September, 2025

Contents

Indicators

Nutrients

Total Nitrogen - Discrete

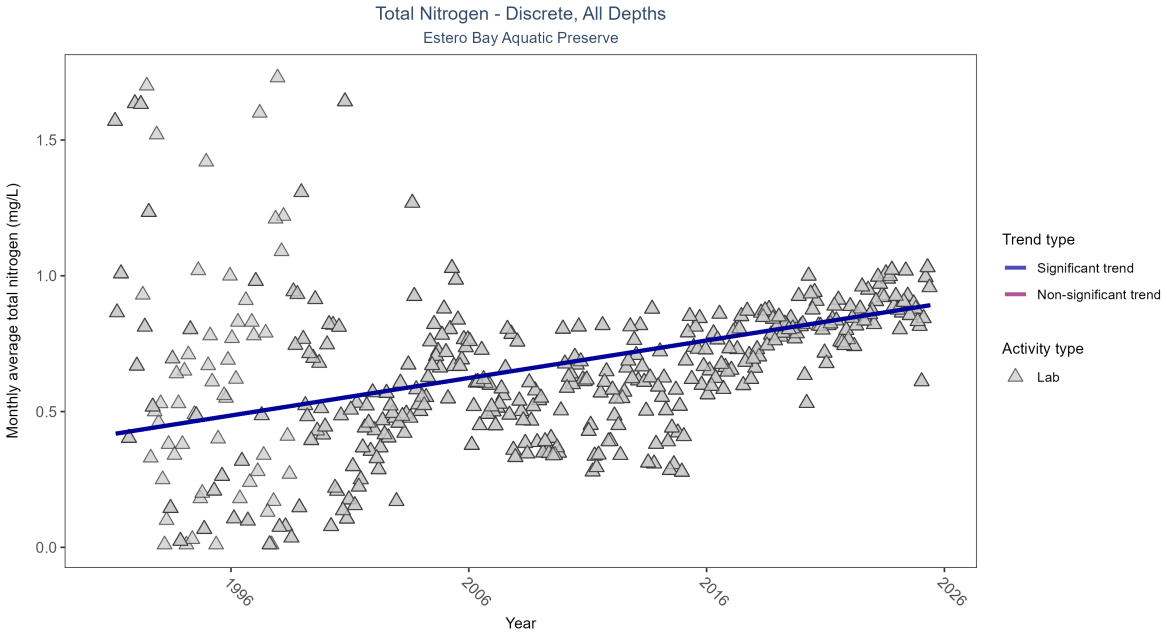

Figure 1: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 1: Seasonal Kendall-Tau Results for - Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	8060	35	1991 - 2025	0.65	0.33344	0.41649	0.01381	0

Monthly average total nitrogen increased by 0.01 mg/L per year.

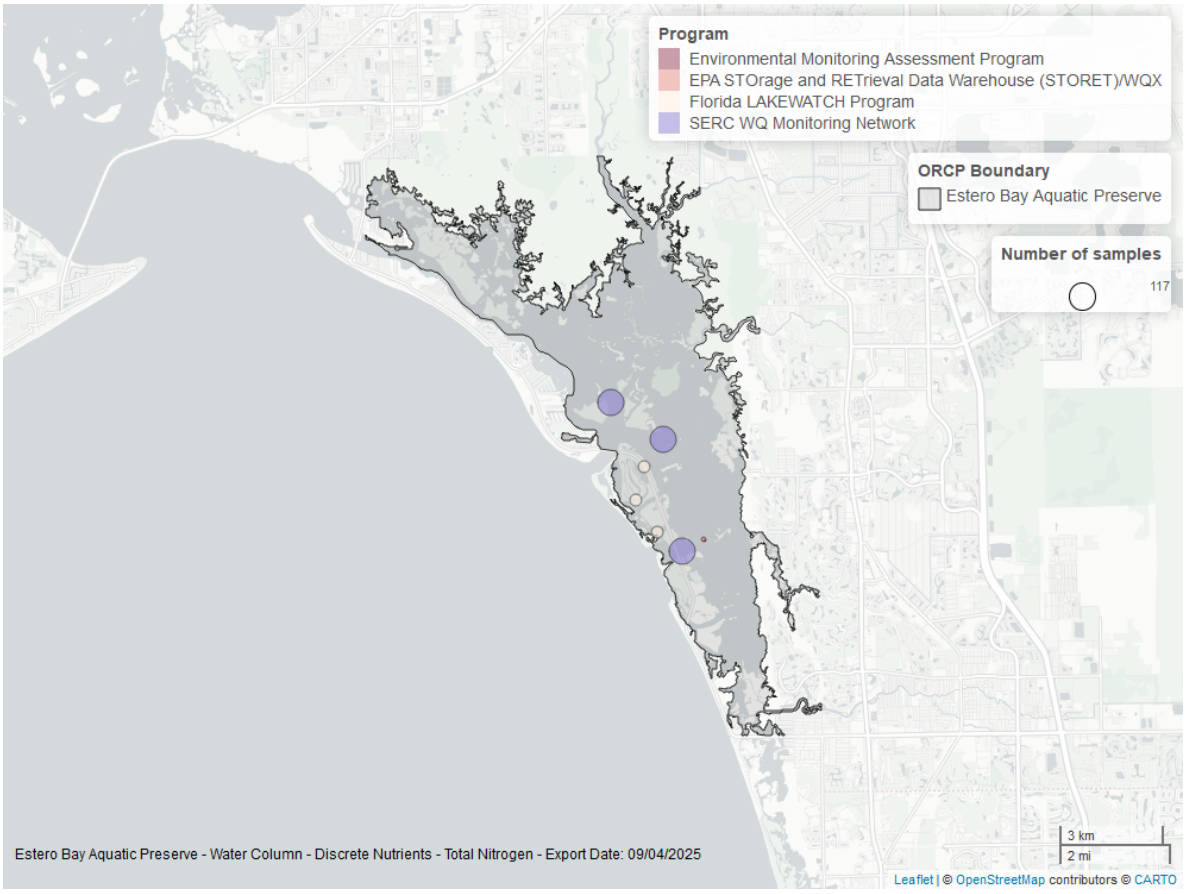

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Phosphorus - Discrete

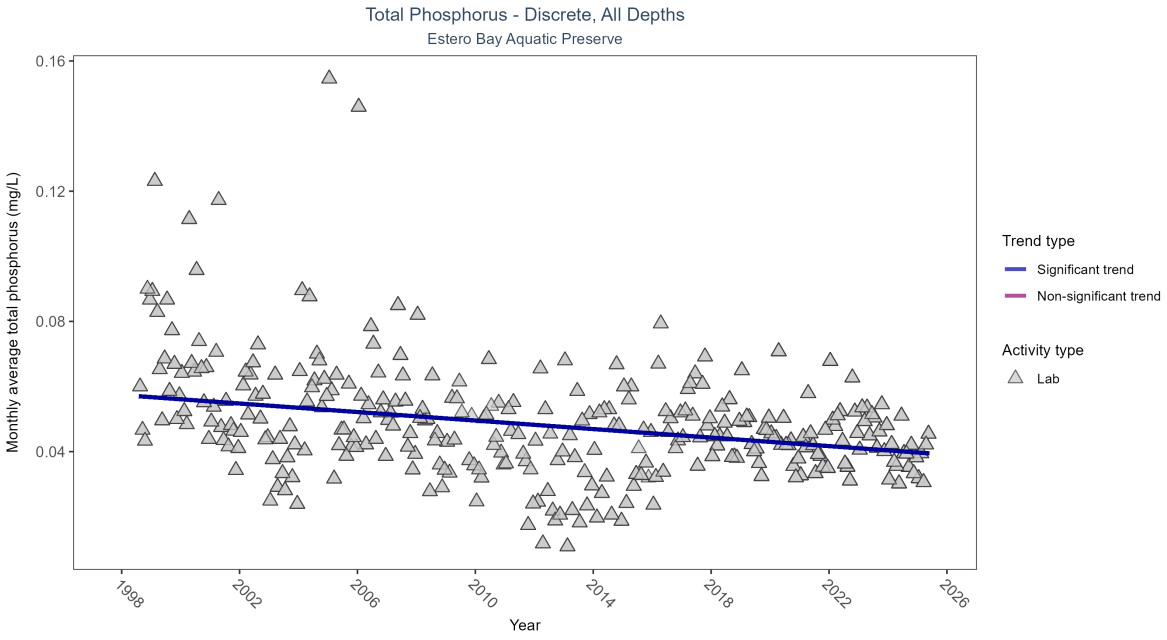

Figure 3: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

Table 2: Seasonal Kendall-Tau Results for - Total Phosphorus

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	3338	28	1998 - 2025	0.042	-0.27244	0.05739	-0.00065	0

Monthly average total phosphorus decreased by less than 0.01 mg/L per year.

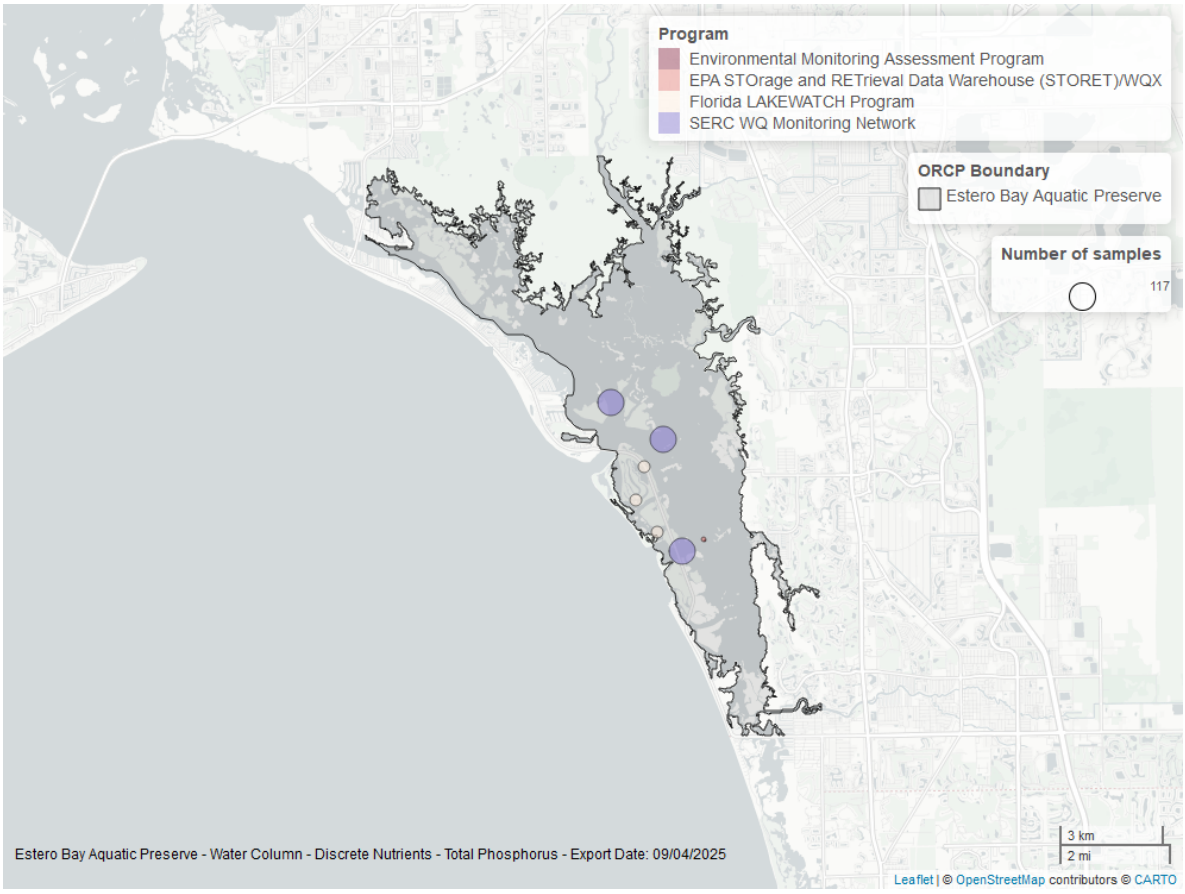

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Quality

Dissolved Oxygen - Discrete

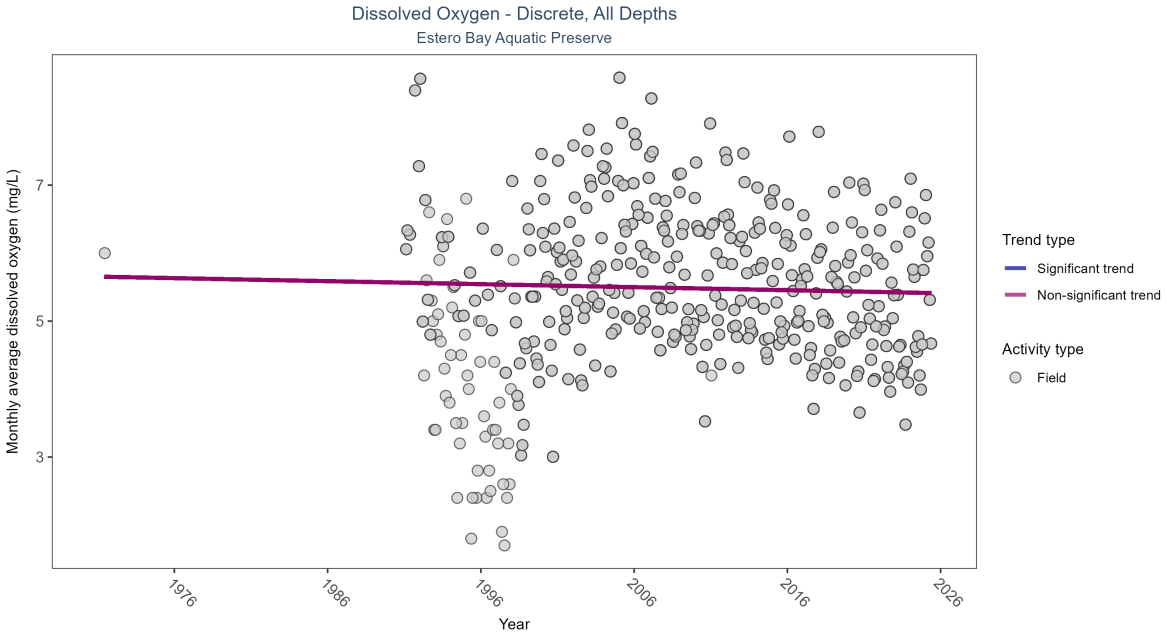

Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 3: Seasonal Kendall-Tau Results for - Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	11479	36	1971 - 2025	5.8	-0.04091	5.65363	-0.00443	0.2592

Dissolved oxygen showed no detectable trend between 1971 and 2025.

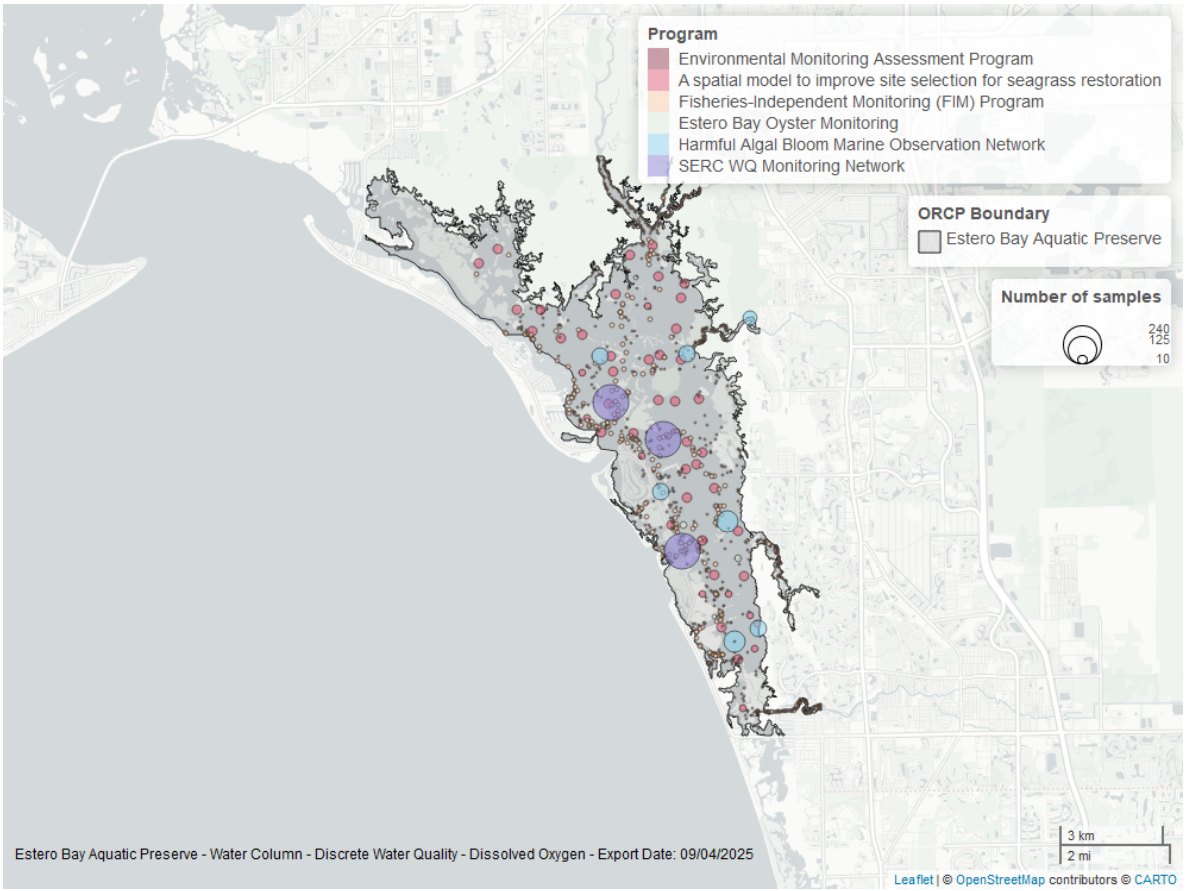

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen - Continuous

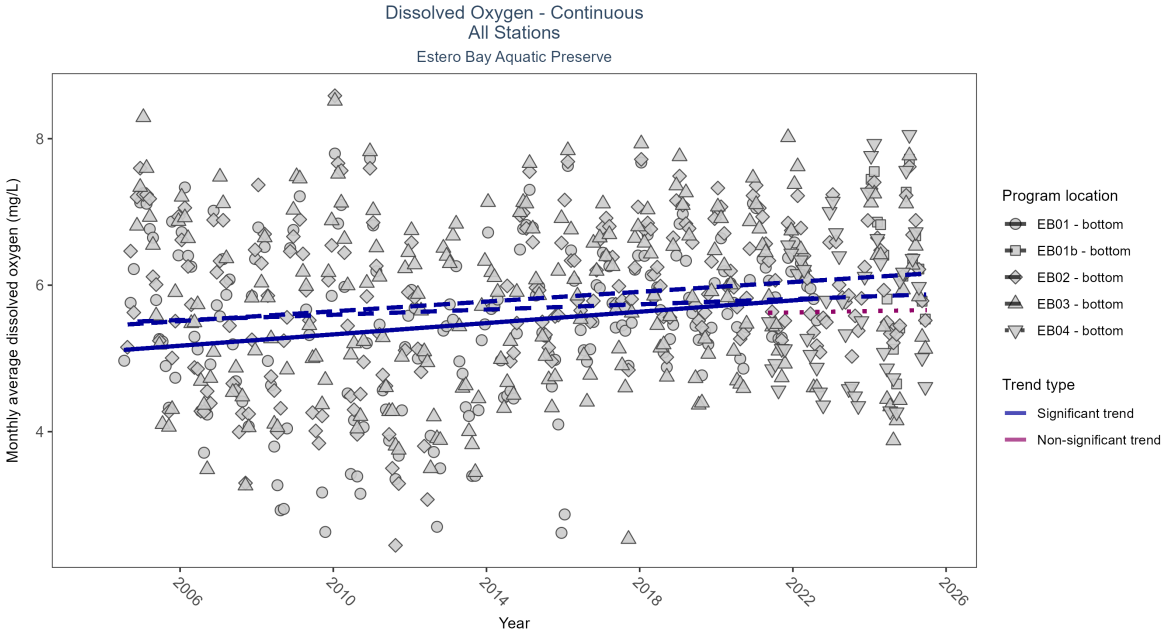

Figure 7: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 4: Seasonal Kendall-Tau Results - Dissolved Oxygen

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	478415	19	2004 - 2022	5.6	0.22	5.1	0.04	0
EB02	Significantly increasing trend	500591	21	2004 - 2025	6.1	0.24	5.44	0.03	0
EB01b	Insufficient data to calculate trend	48993	2	2024 - 2025	6.3	-	-	-	-
EB03	Significantly increasing trend	490463	21	2004 - 2025	5.9	0.14	5.49	0.02	0.0065
EB04	No significant trend	123179	5	2021 - 2025	5.8	0.06	5.62	0.01	0.924

At three program locations, monthly average dissolved oxygen increased between 0.02 and 0.04 mg/L per year. No detectable change in monthly average dissolved oxygen was observed at one location. There was insufficient data to fit a model for one location.

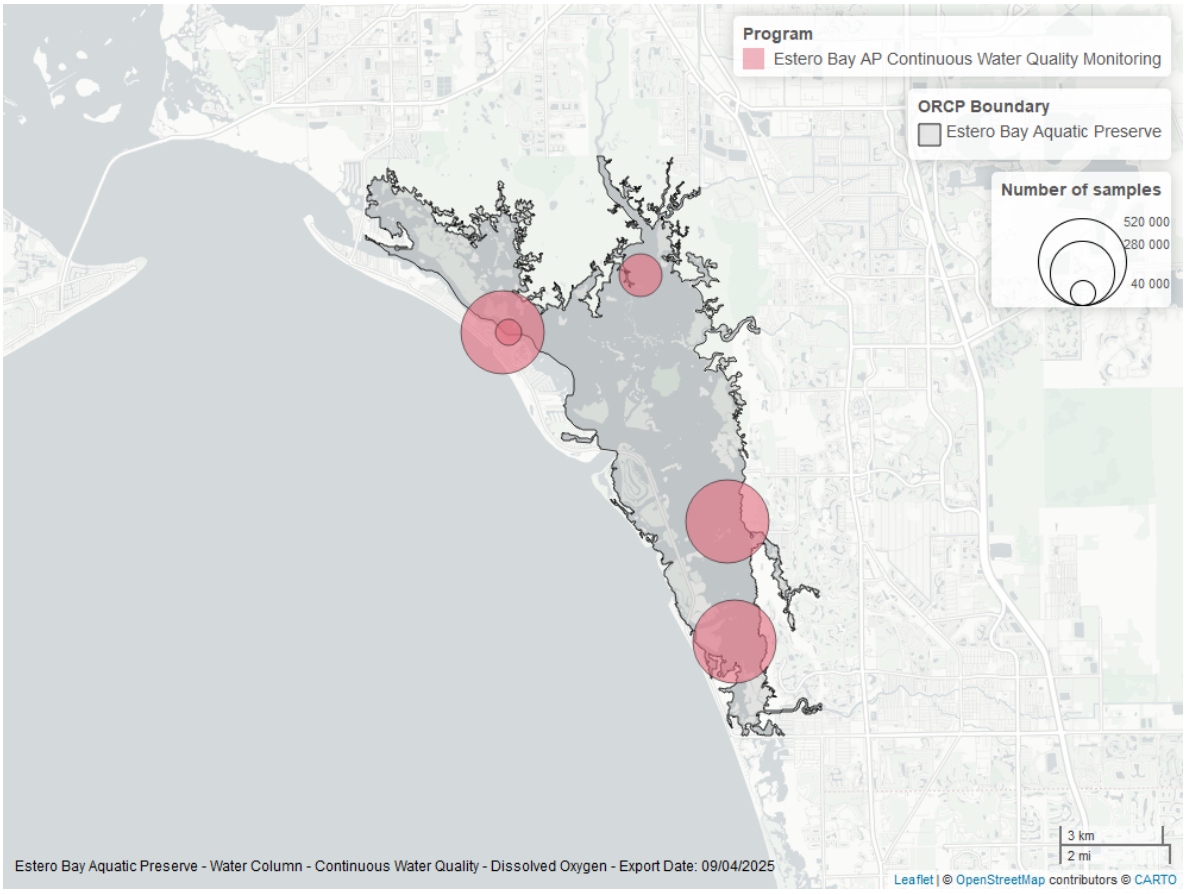

Figure 8: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Discrete

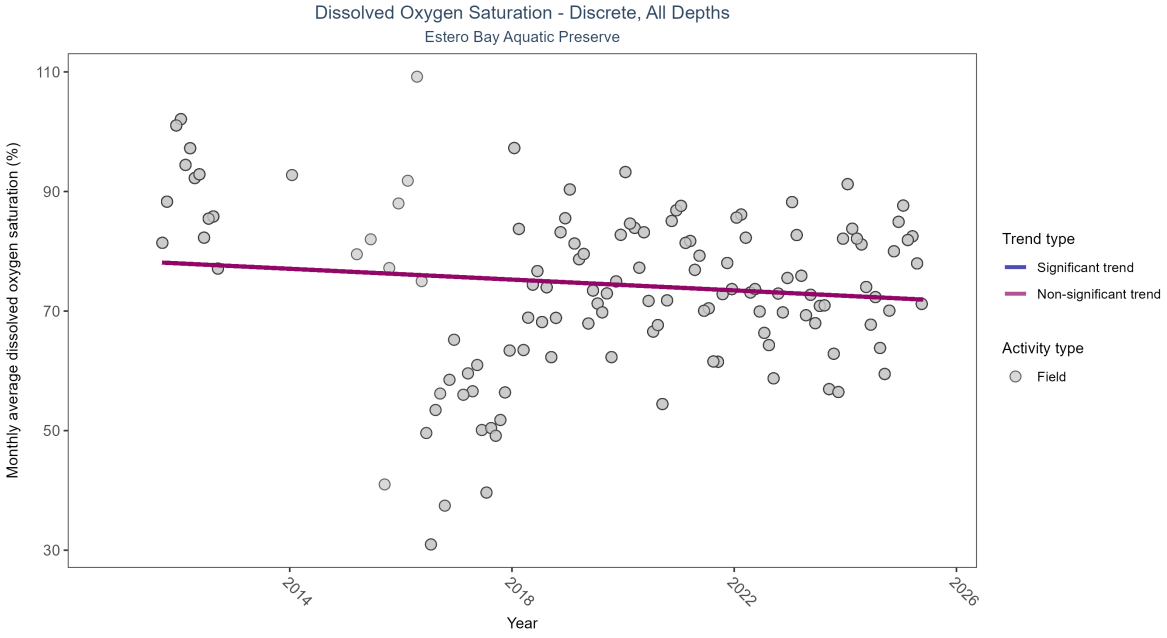

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) are included in the plot.

Table 5: Seasonal Kendall-Tau Results for - Dissolved Oxygen Saturation

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	2916	14	2011 - 2025	82.1143	-0.11588	78.42533	-0.45168	0.0883

Dissolved oxygen saturation showed no detectable trend between 2011 and 2025.

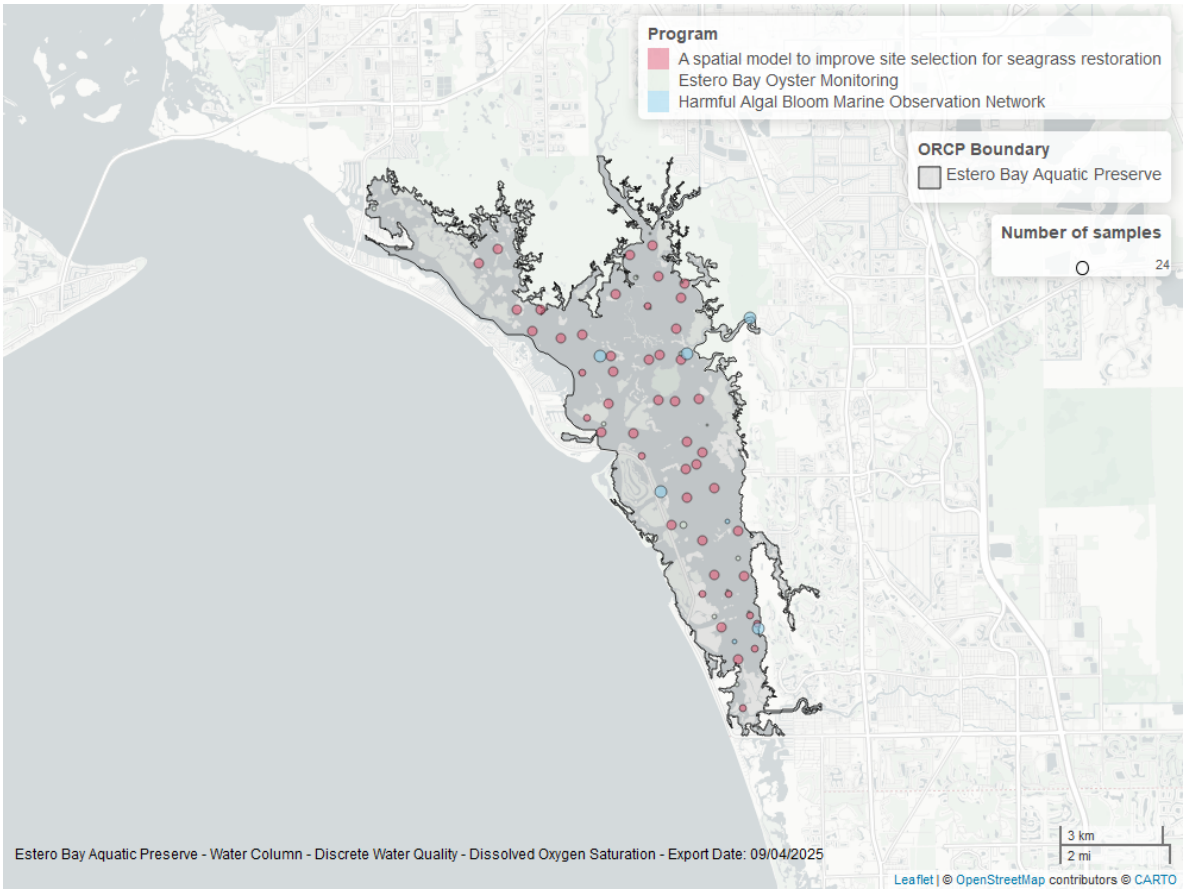

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

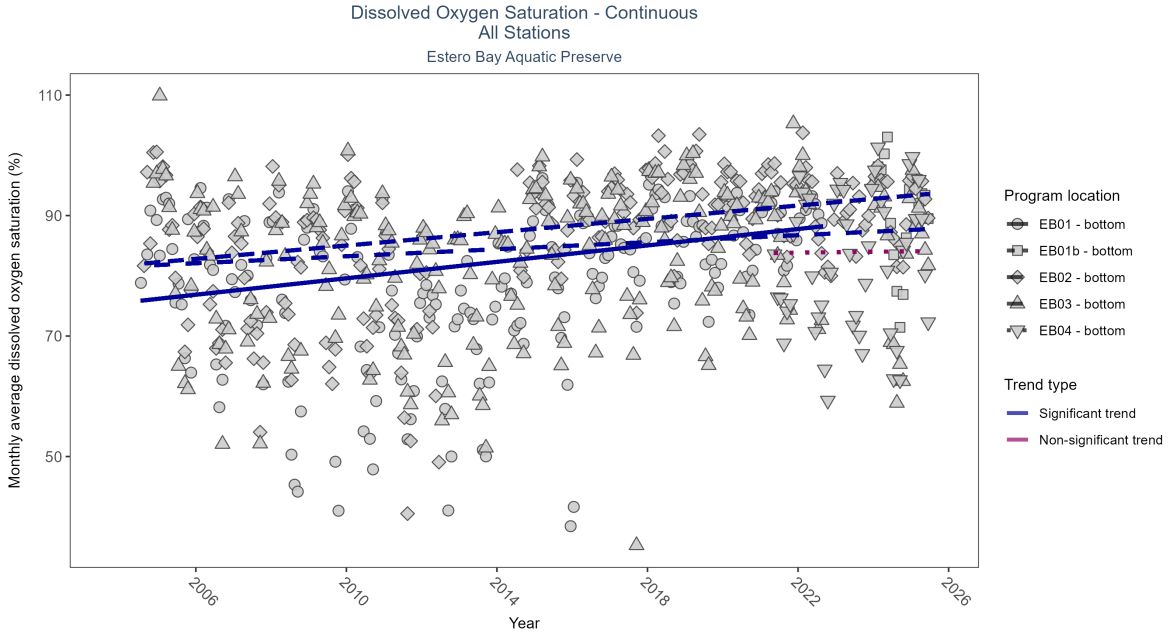

Figure 11: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 6: Seasonal Kendall-Tau Results - Dissolved Oxygen Saturation

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	480233	19	2004 - 2022	81.6	0.31	75.5	0.68	0
EB02	Significantly increasing trend	500828	21	2004 - 2025	88.1	0.35	81.7	0.55	0
EB01b	Insufficient data to calculate trend	49703	2	2024 - 2025	90.1	-	-	-	-
EB03	Significantly increasing trend	491989	21	2004 - 2025	83.8	0.19	81.5	0.29	1e-04
EB04	No significant trend	135013	5	2021 - 2025	83.5	0.04	83.77	0.07	0.9273

At three program locations, monthly average dissolved oxygen saturation increased between 0.29 and 0.68% per year. No detectable change in monthly average dissolved oxygen saturation was observed at one location. There was insufficient data to fit a model for one location.

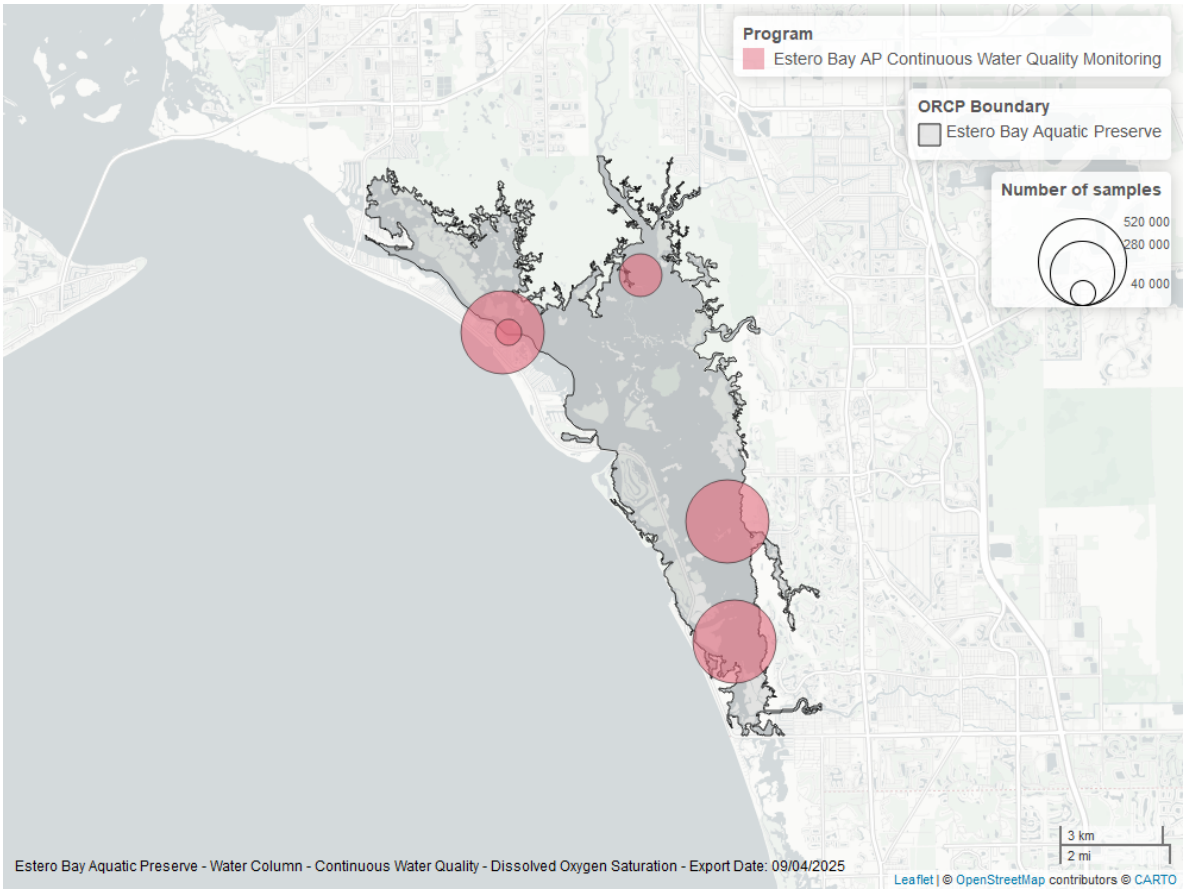

Figure 12: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Discrete

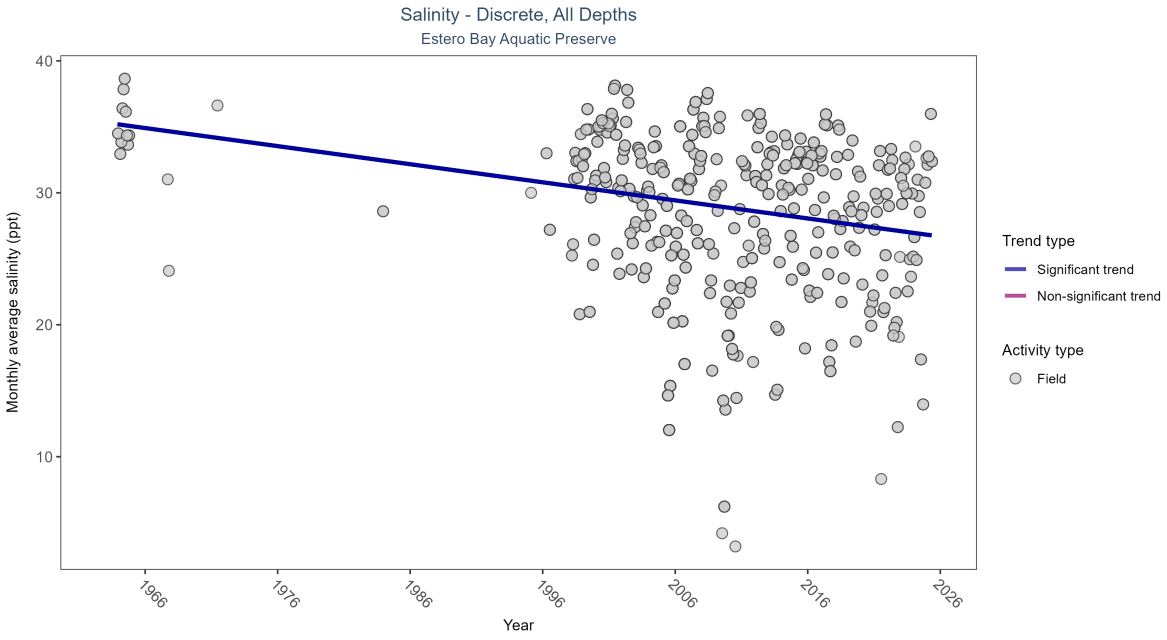

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 7: Seasonal Kendall-Tau Results for - Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
All	Significantly decreasing trend	5334	35	1963 - 2025	32.295	-0.25663	35.32108	-0.13705	0

Monthly average salinity decreased by 0.14 ppt per year.

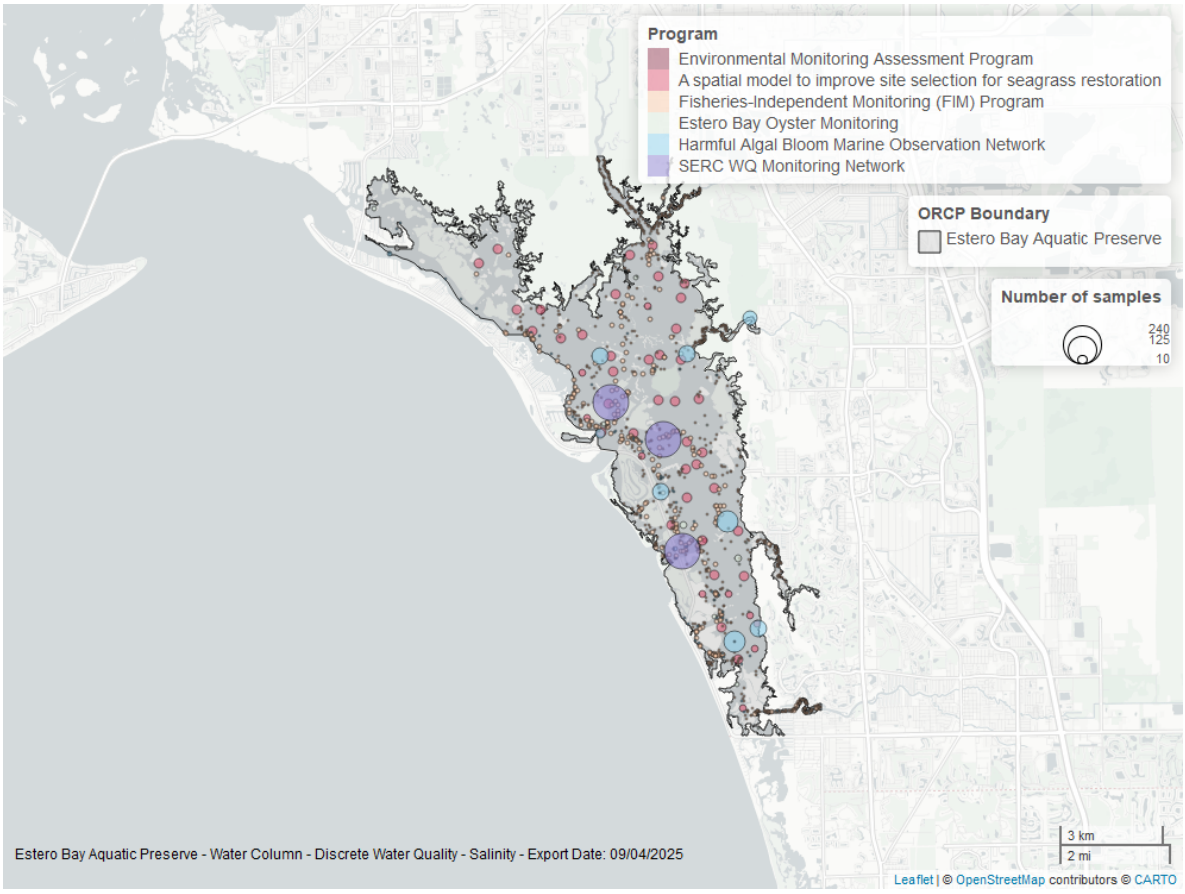

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

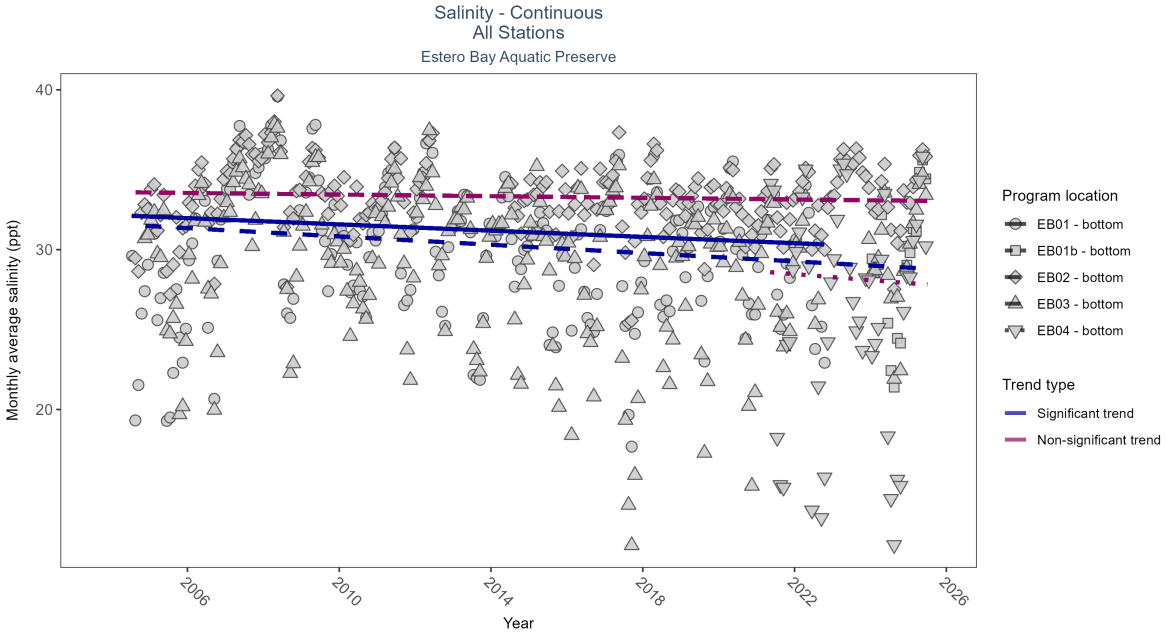

Figure 15: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 8: Seasonal Kendall-Tau Results - Salinity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly decreasing trend	567163	19	2004 - 2022	30.7	-0.13	32.17	-0.1	0.011
EB02	No significant trend	589651	21	2004 - 2025	33.6	-0.07	33.6	-0.03	0.15
EB03	Significantly decreasing trend	586711	22	2004 - 2025	30.9	-0.21	31.61	-0.13	0
EB01b	Insufficient data to calculate trend	47853	2	2024 - 2025	30.0	-	-	-	-
EB04	No significant trend	134501	5	2021 - 2025	28.0	-0.12	28.66	-0.19	0.5758

At two program locations, monthly average salinity decreased by 0.1 ppt per year at one site and by 0.13 ppt per year at the other. No detectable change in monthly average salinity was observed at two locations. There was insufficient data to fit a model for one location.

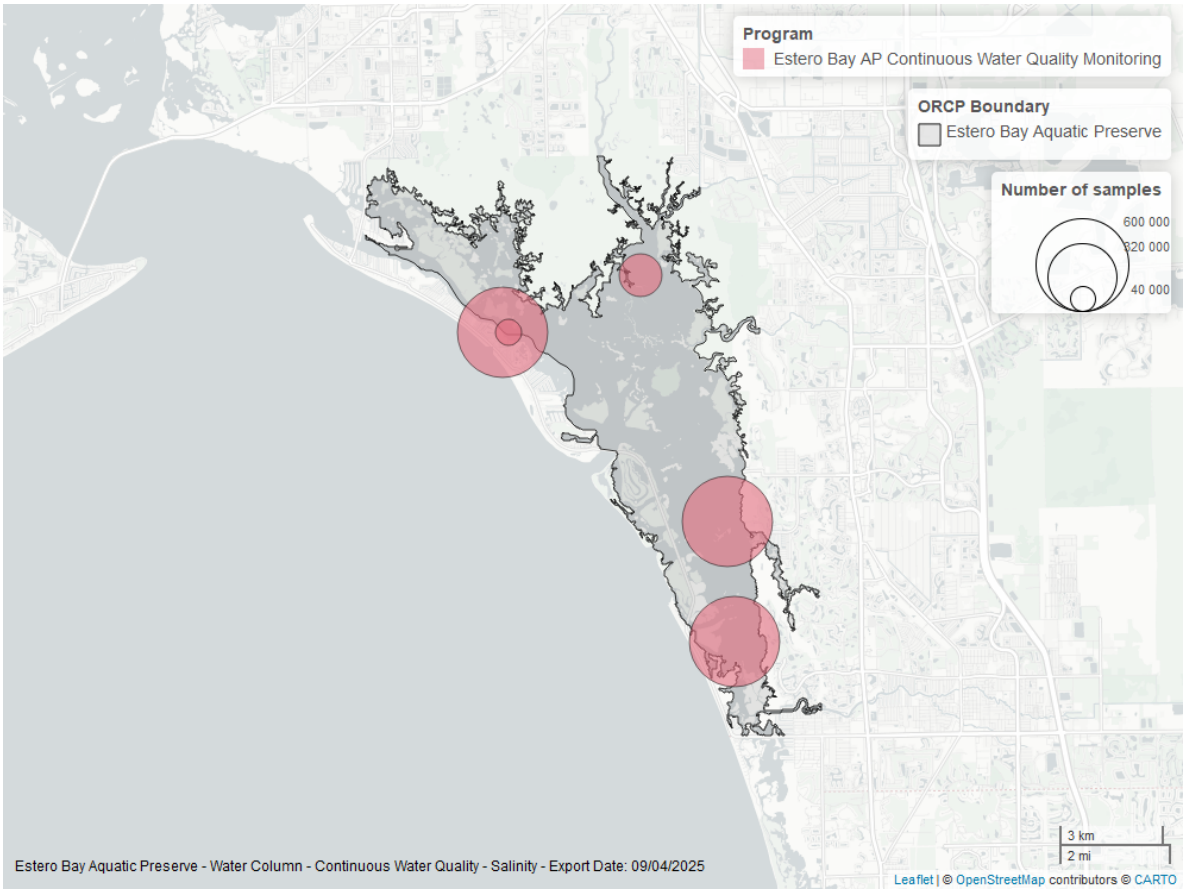

Figure 16: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Discrete

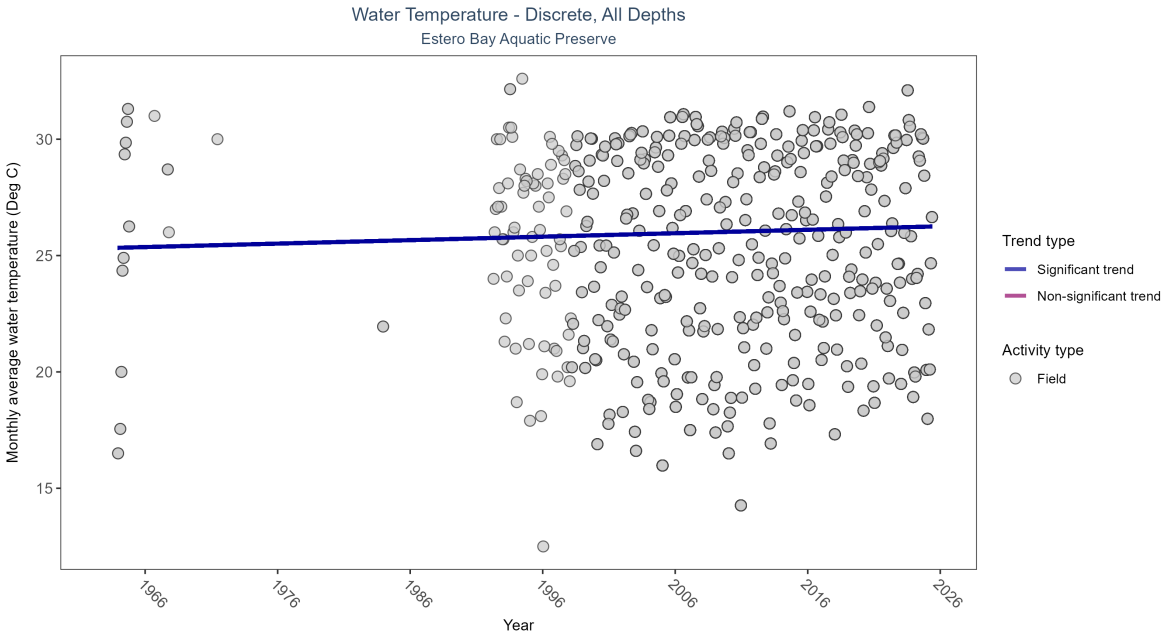

Figure 17: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 9: Seasonal Kendall-Tau Results for - Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	11042	40	1963 - 2025	25.9	0.08737	25.31991	0.01487	0.0119

Monthly average water temperature increased by 0.01°C per year.

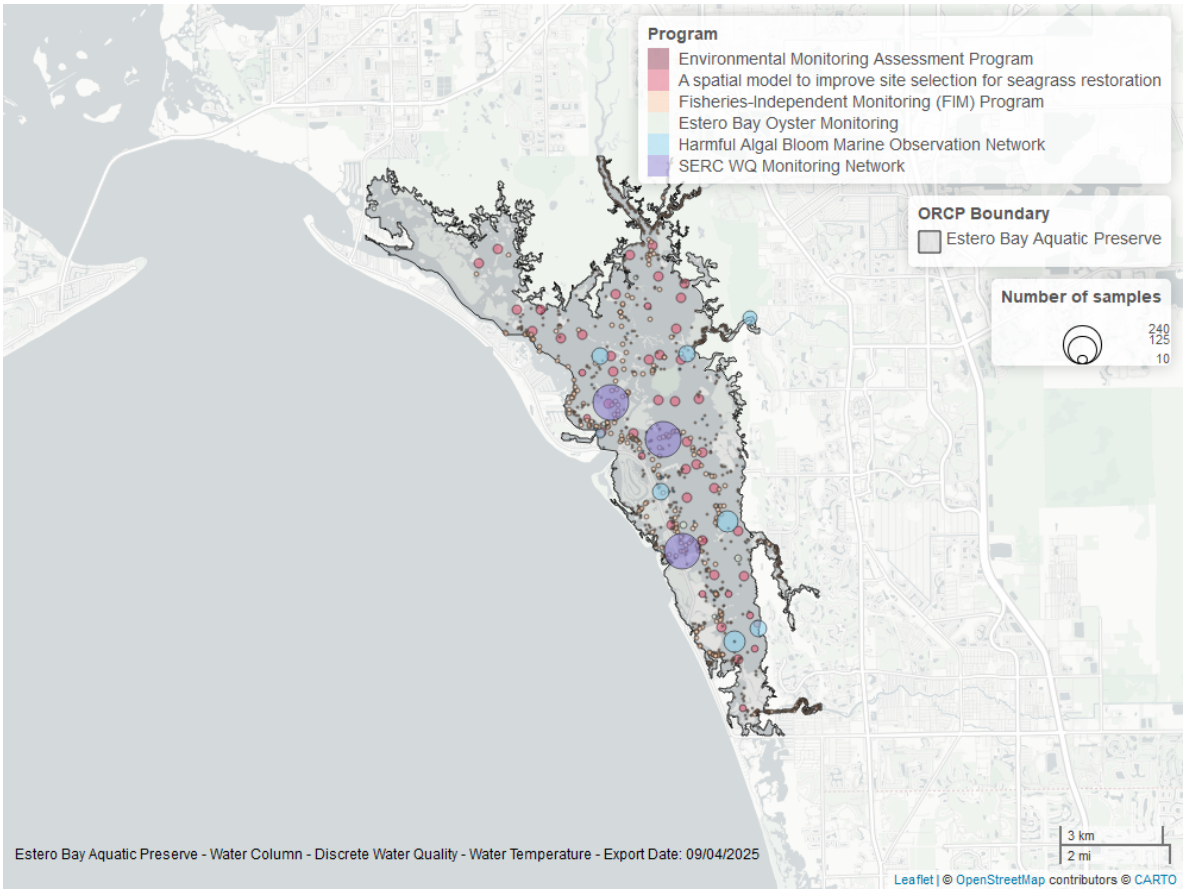

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

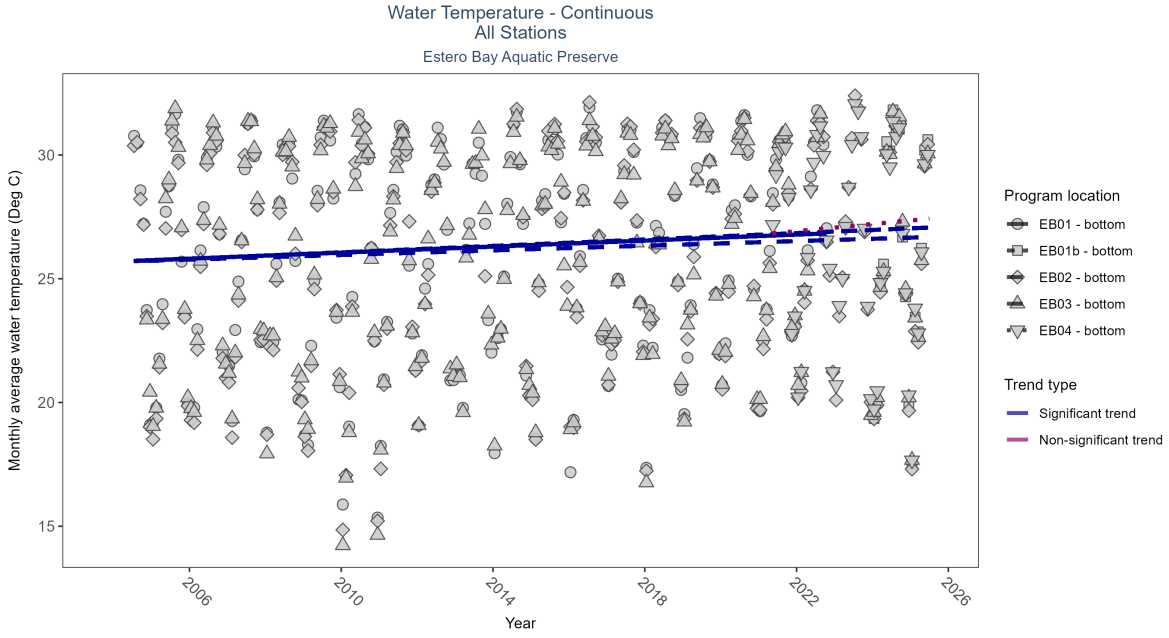

Figure 19: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 10: Seasonal Kendall-Tau Results - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	617636	19	2004 - 2022	26.8	0.25	25.69	0.06	0
EB02	Significantly increasing trend	634870	22	2004 - 2025	26.5	0.31	25.68	0.06	0
EB01b	Insufficient data to calculate trend	49701	2	2024 - 2025	26.4	-	-	-	-
EB03	Significantly increasing trend	625637	22	2004 - 2025	26.4	0.18	25.68	0.05	2e-04
EB04	No significant trend	144519	5	2021 - 2025	27.1	0.12	26.78	0.14	0.3153

At three program locations, monthly average water temperature increased between 0.05 and 0.06°C per year. No detectable change in monthly average water temperature was observed at one location. There was insufficient data to fit a model for one location.

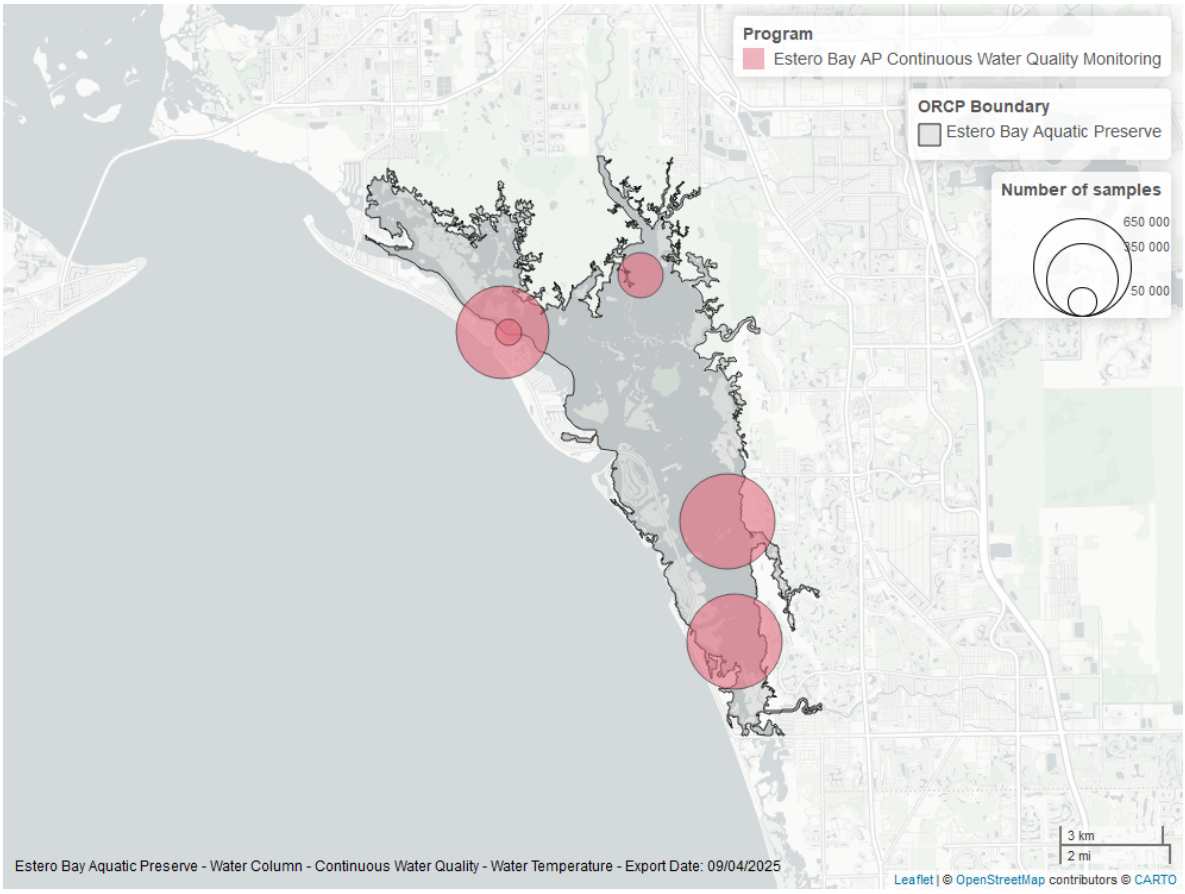

Figure 20: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Discrete

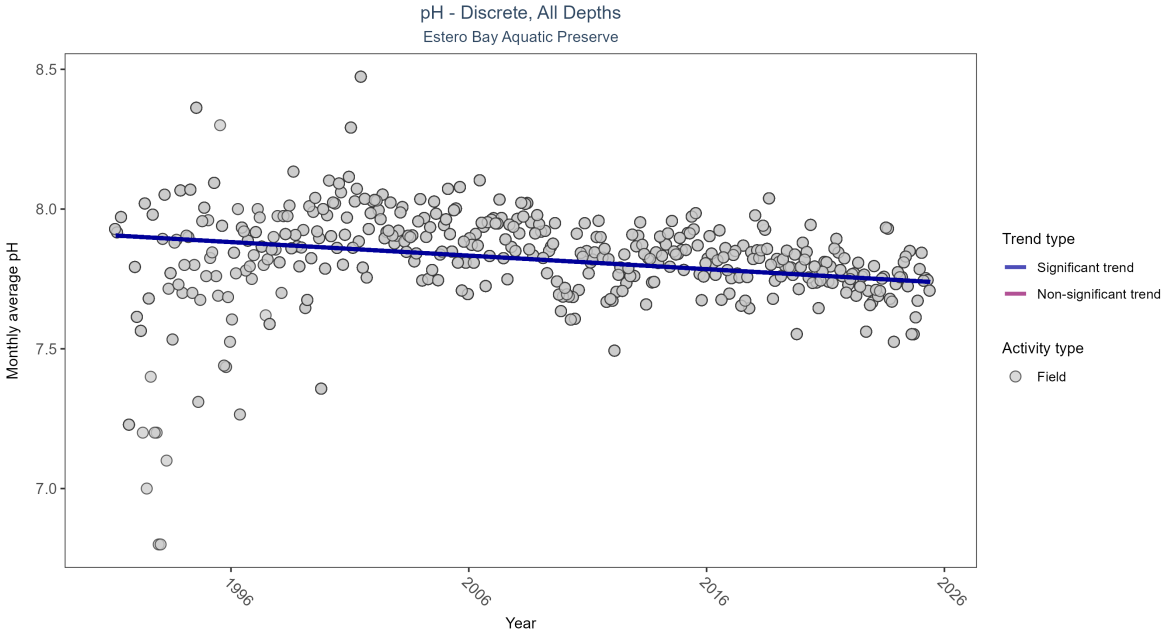

Figure 21: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 11: Seasonal Kendall-Tau Results for - pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly decreasing trend	10838	35	1991 - 2025	7.9	-0.21866	7.90605	-0.00484	0

Monthly average pH decreased by less than 0.01 pH units per year.

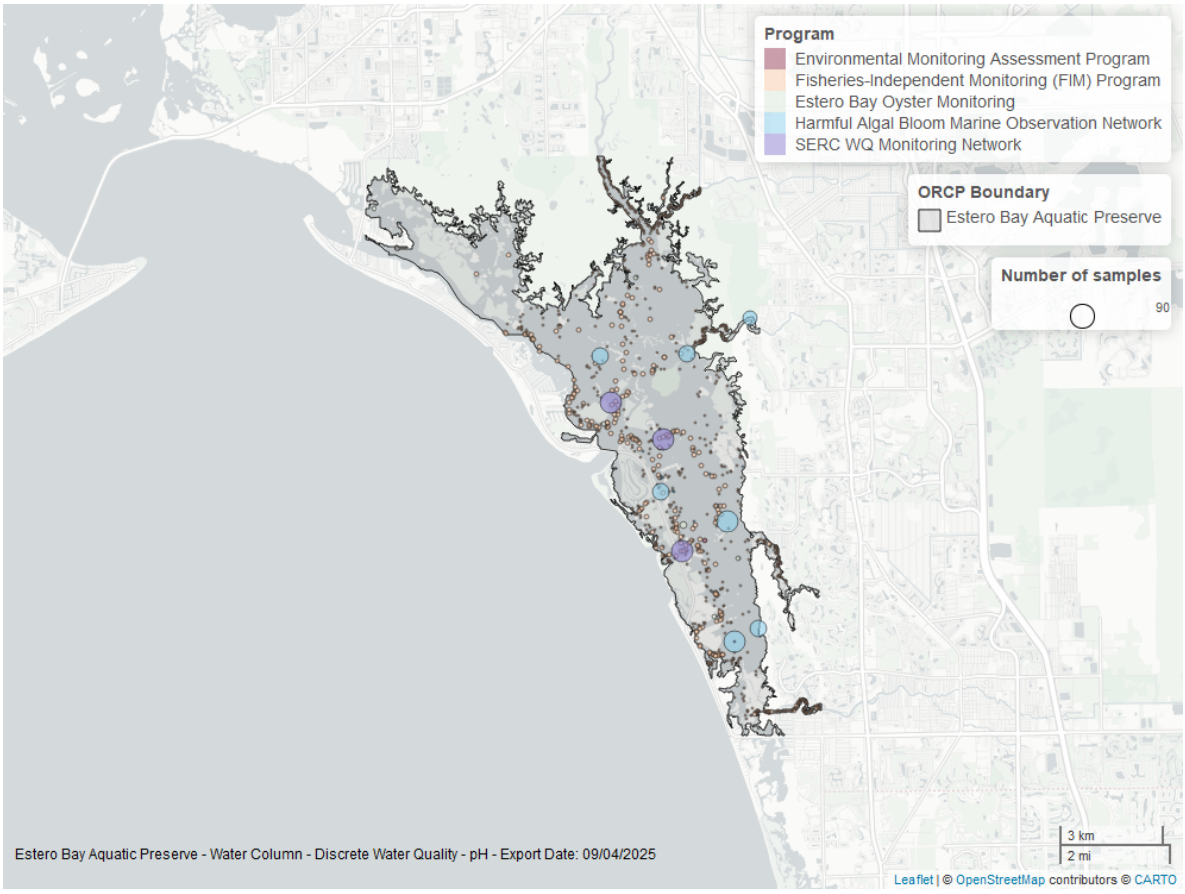

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

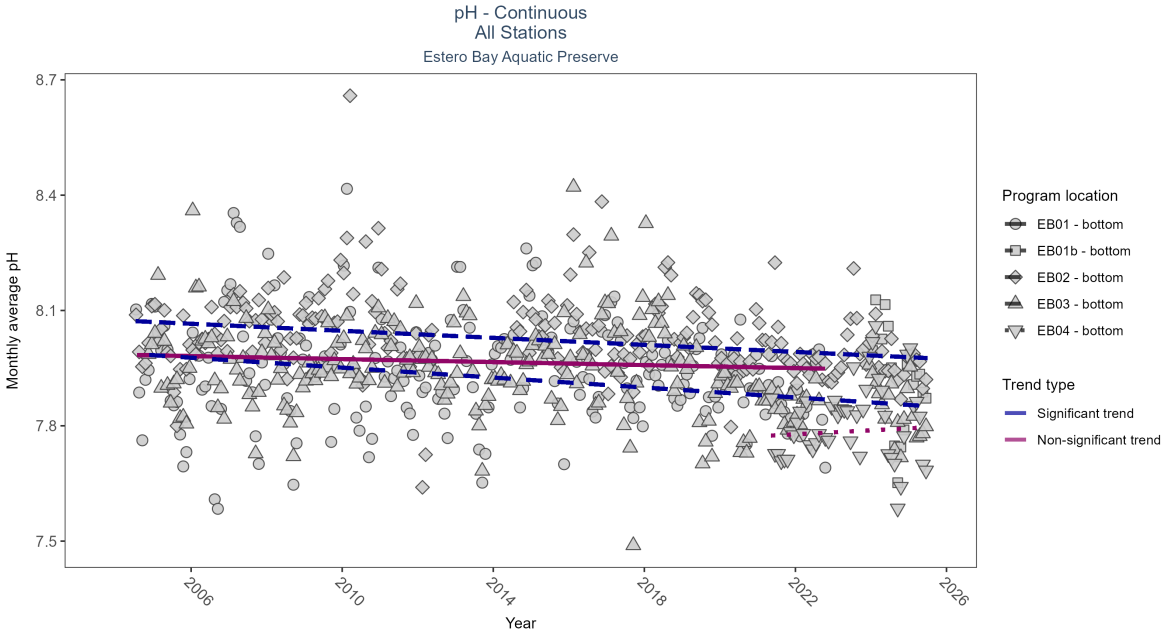

Figure 23: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 12: Seasonal Kendall-Tau Results - pH

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	No significant trend	562188	19	2004 - 2022	7.9	-0.08	7.99	0	0.1157
EB02	Significantly decreasing trend	574197	21	2004 - 2025	8.0	-0.23	8.07	0	0
EB03	Significantly decreasing trend	578121	22	2004 - 2025	7.9	-0.26	7.99	-0.01	0
EB01b	Insufficient data to calculate trend	46922	2	2024 - 2025	7.9	-	-	-	-
EB04	No significant trend	139525	5	2021 - 2025	7.8	0.07	7.77	0.01	0.8521

At two program locations, monthly average pH decreased by less than 0.01 pH units per year at one site and by 0.01 pH units per year at the other. No detectable change in monthly average pH was observed at two locations. There was insufficient data to fit a model for one location.

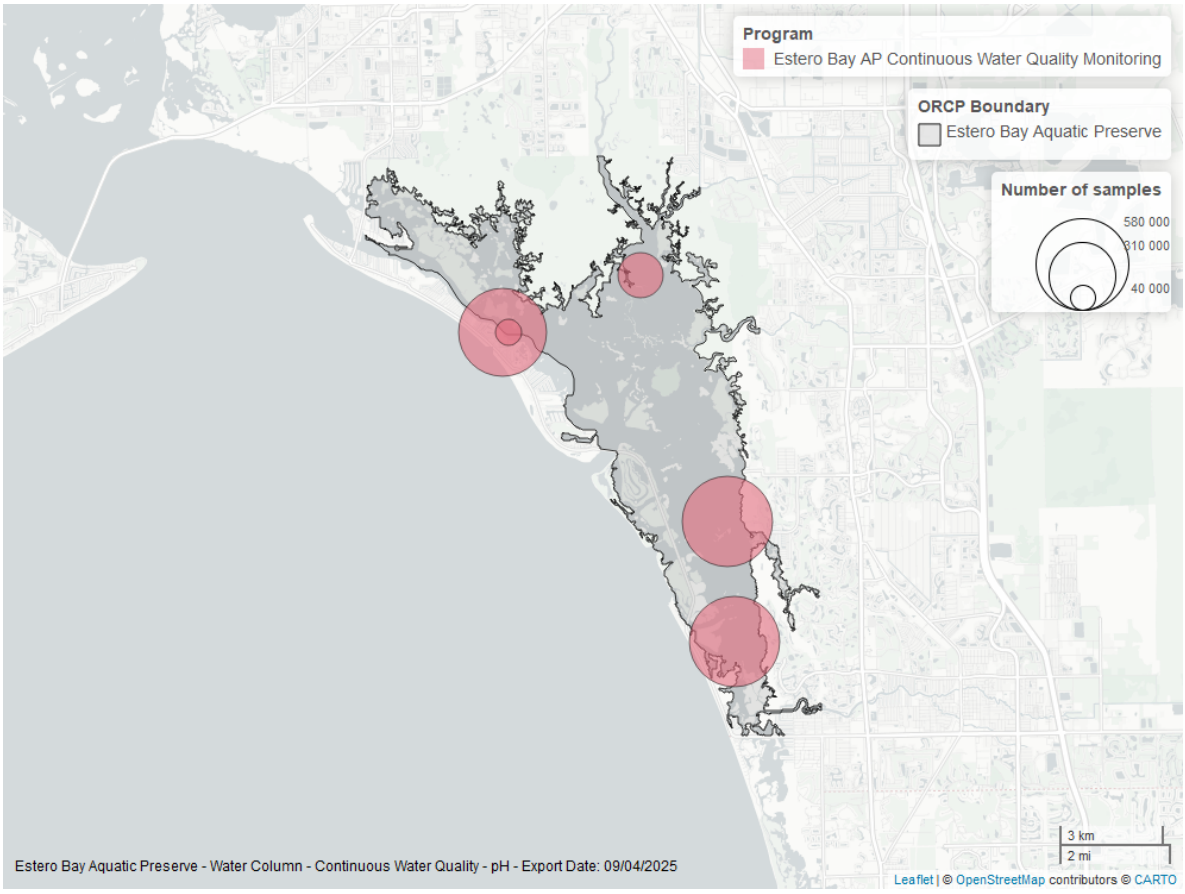

Figure 24: Map showing location of ph continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Clarity

Turbidity - Discrete

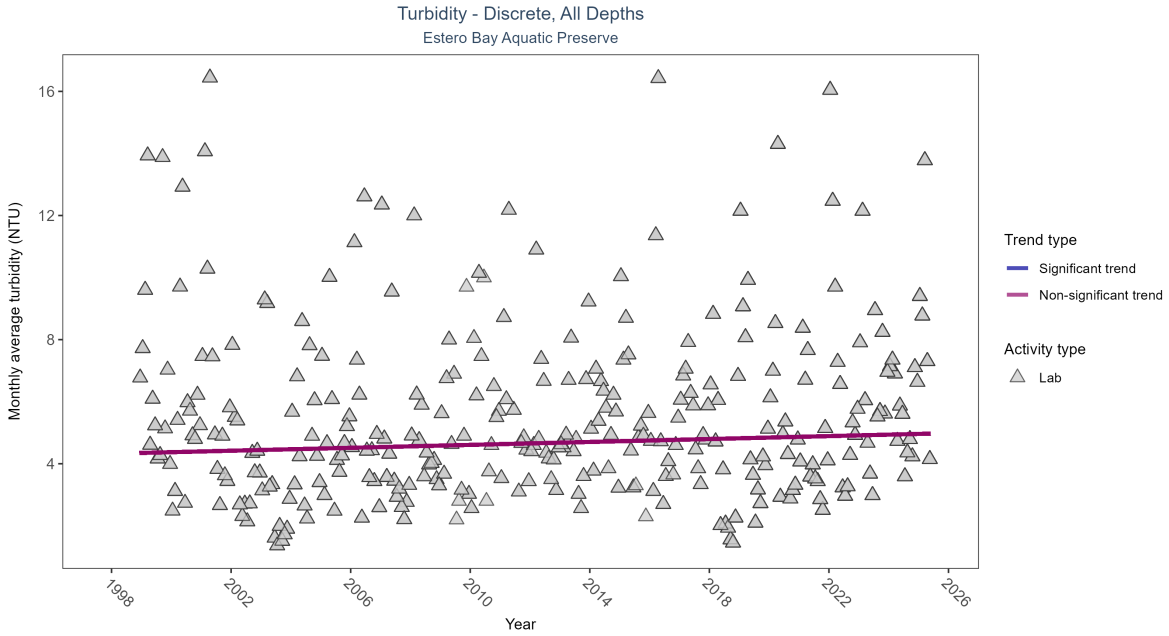

Figure 25: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 13: Seasonal Kendall-Tau Results for - Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	3128	28	1998 - 2025	4.14	0.0656	4.32494	0.02356	0.0918

Turbidity showed no detectable trend between 1998 and 2025.

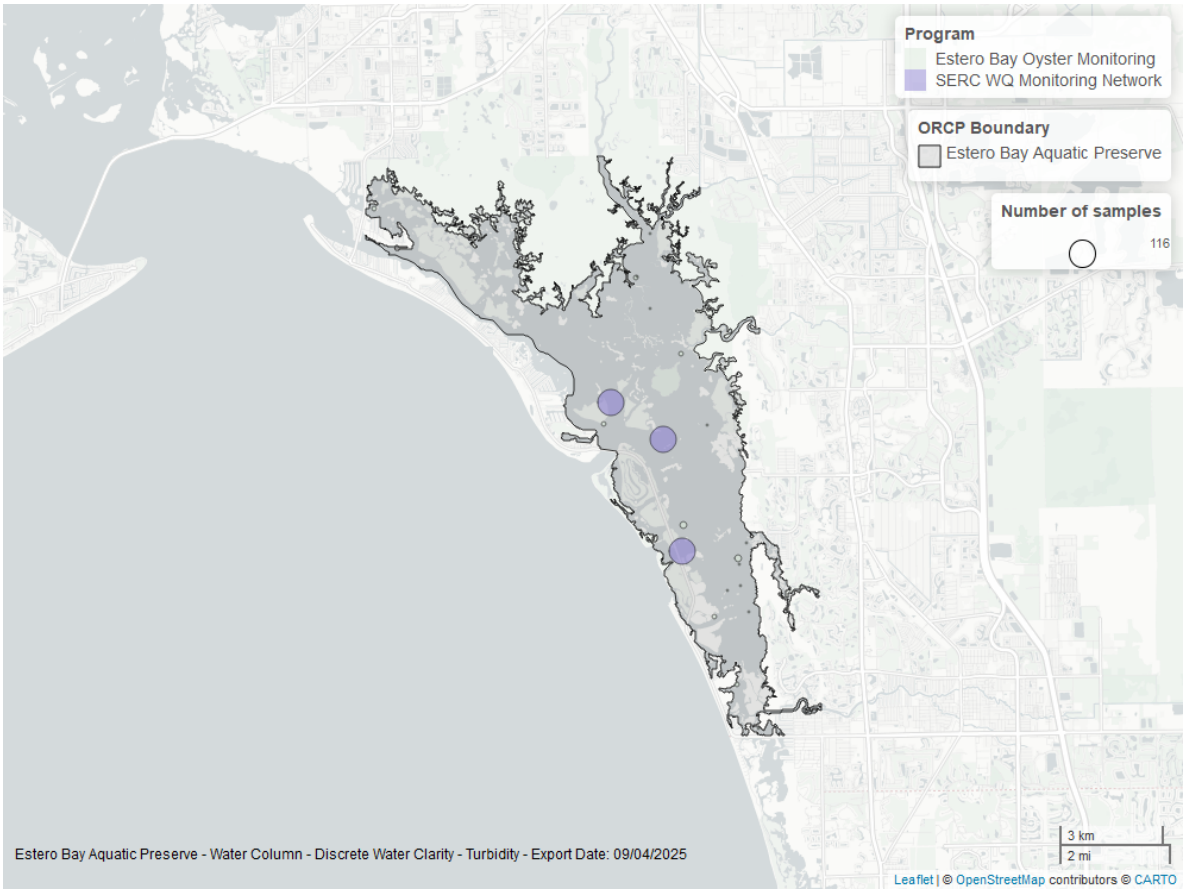

Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

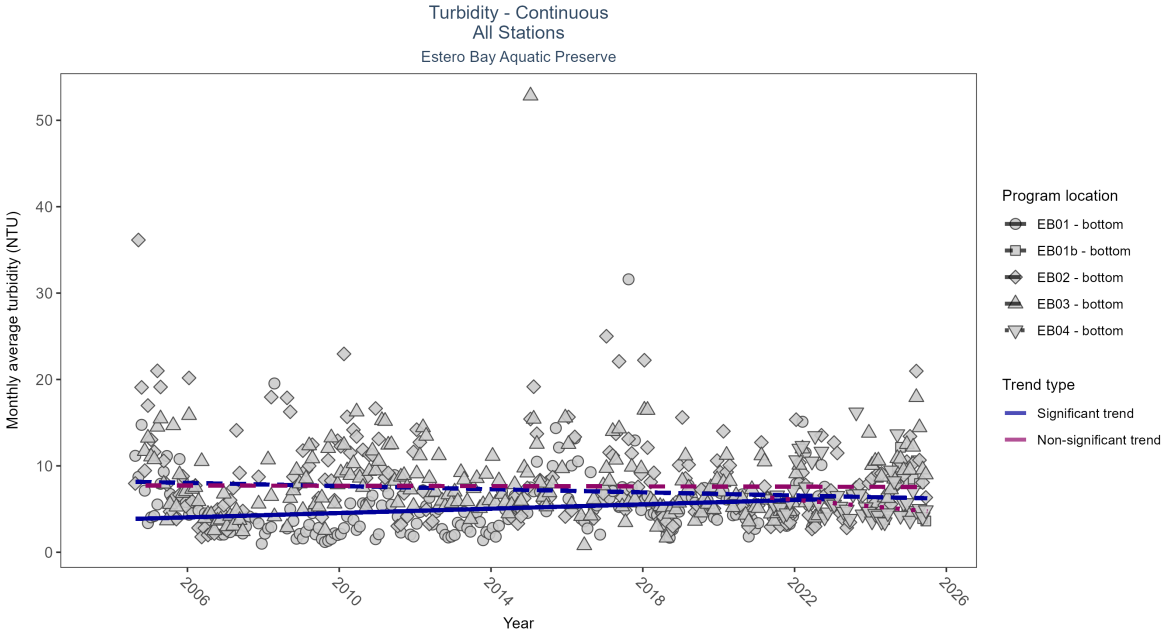

Figure 27: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 14: Seasonal Kendall-Tau Results - Turbidity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	510965	19	2004 - 2022	4	0.18	3.79	0.13	5e-04
EB01b	Insufficient data to calculate trend	46725	2	2024 - 2025	5	-	-	-	-
EB02	Significantly decreasing trend	485010	21	2004 - 2025	5	-0.11	8.21	-0.09	0.0285
EB03	No significant trend	466855	22	2004 - 2025	6	-0.02	7.74	-0.01	0.8142
EB04	No significant trend	132067	5	2021 - 2025	5	-0.18	6.45	-0.38	0.1709

At one program location, monthly average turbidity increased by 0.13 NTU per year. At one program location, monthly average turbidity decreased by 0.09 NTU per year. No detectable change in monthly average turbidity was observed at two locations. There was insufficient data to fit a model for one location.

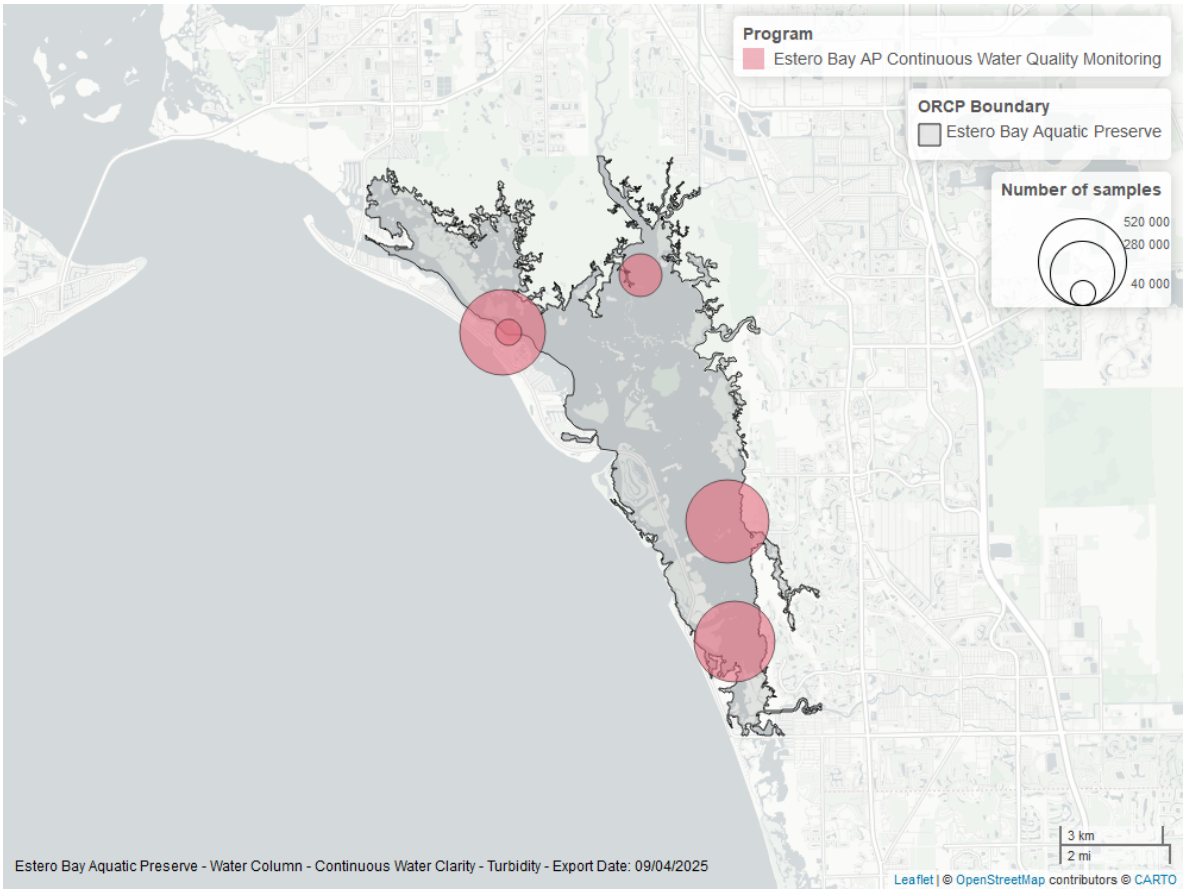

Figure 28: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Suspended Solids - Discrete

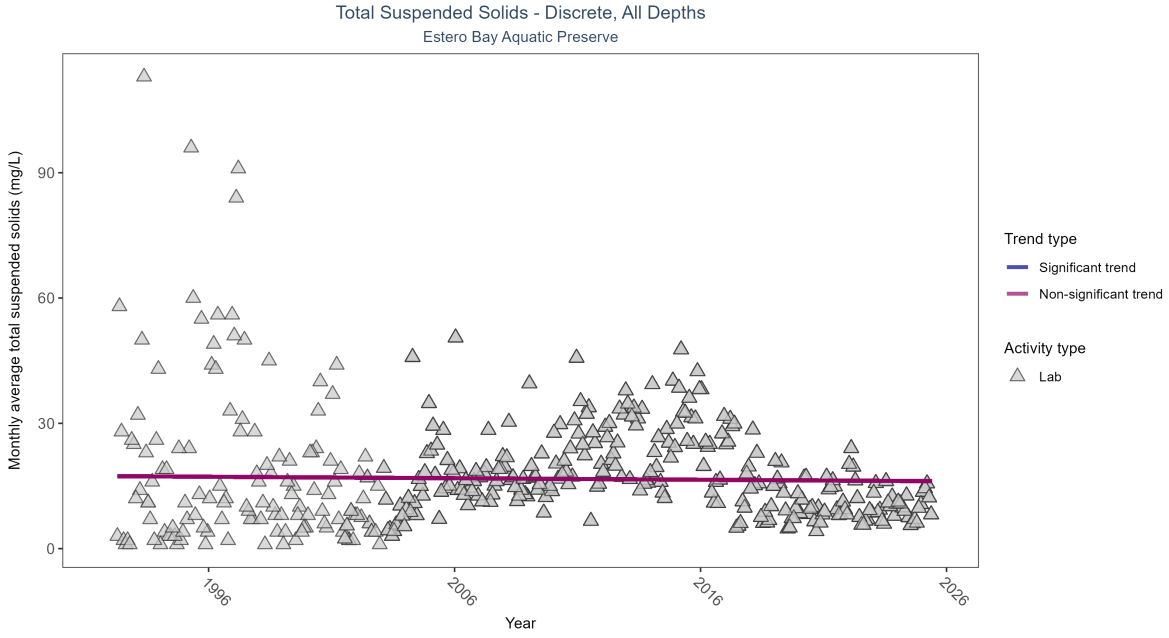

Figure 29: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

Table 15: Seasonal Kendall-Tau Results for - Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	5546	34	1992 - 2025	13.7	-0.02359	17.35179	-0.03586	0.4811

Total suspended solids showed no detectable trend between 1992 and 2025.

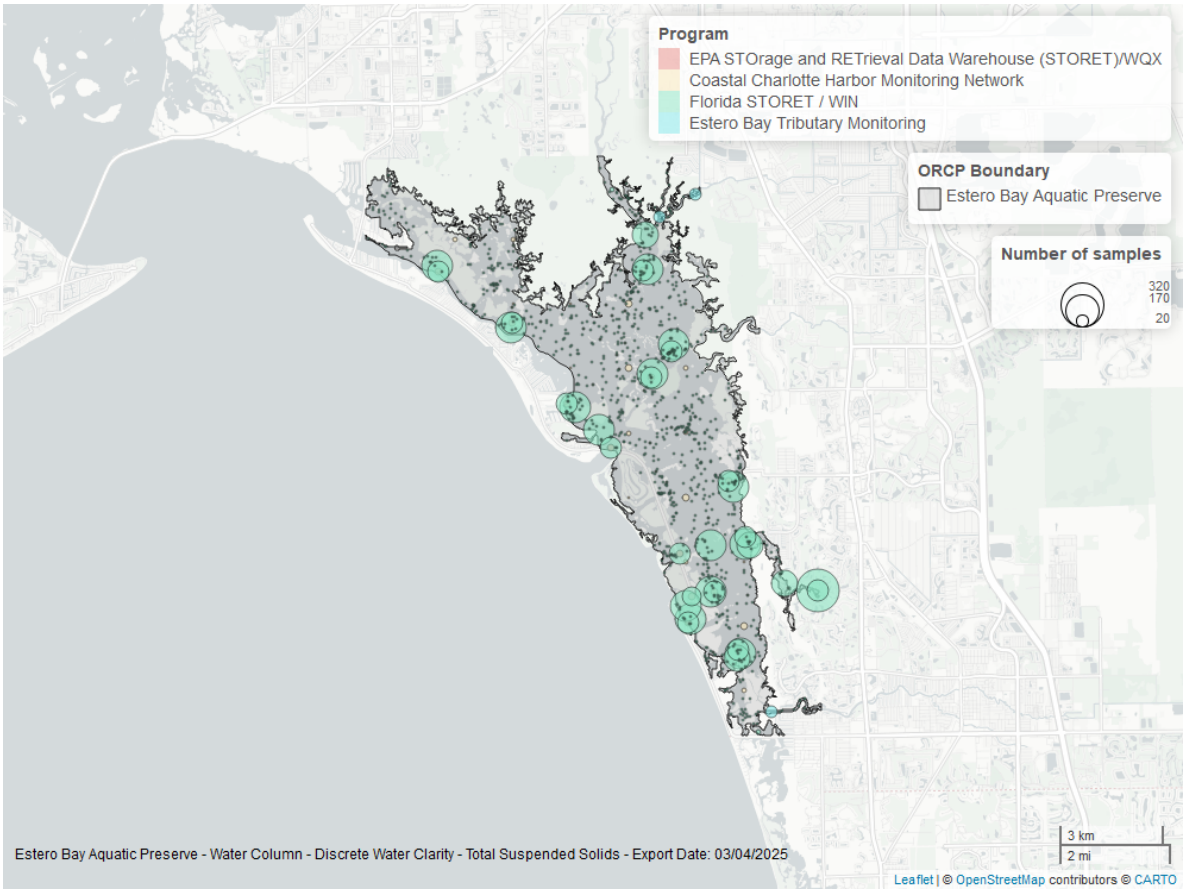

Figure 30: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Uncorrected for Pheophytin - Discrete

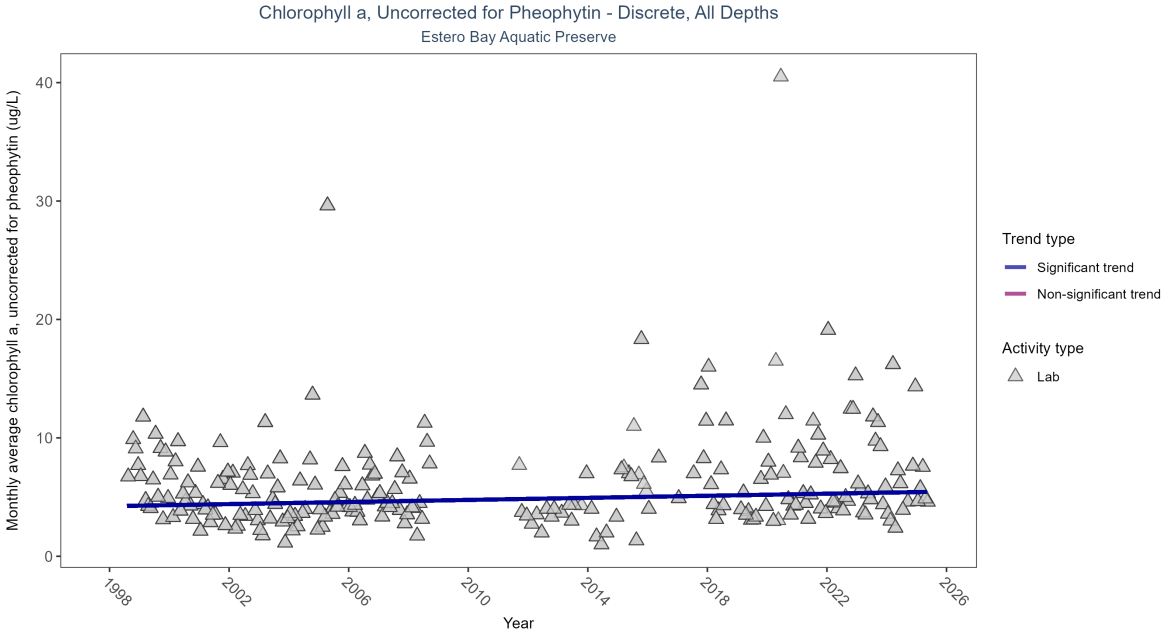

Figure 31: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 16: Seasonal Kendall-Tau Results for - Chlorophyll a, Uncorrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	1157	26	1998 - 2025	4.3286	0.12084	4.2302	0.04401	0.0083

Monthly average chlorophyll a, uncorrected for pheophytin, increased by 0.04 µg/L per year, indicating a decrease in water clarity.

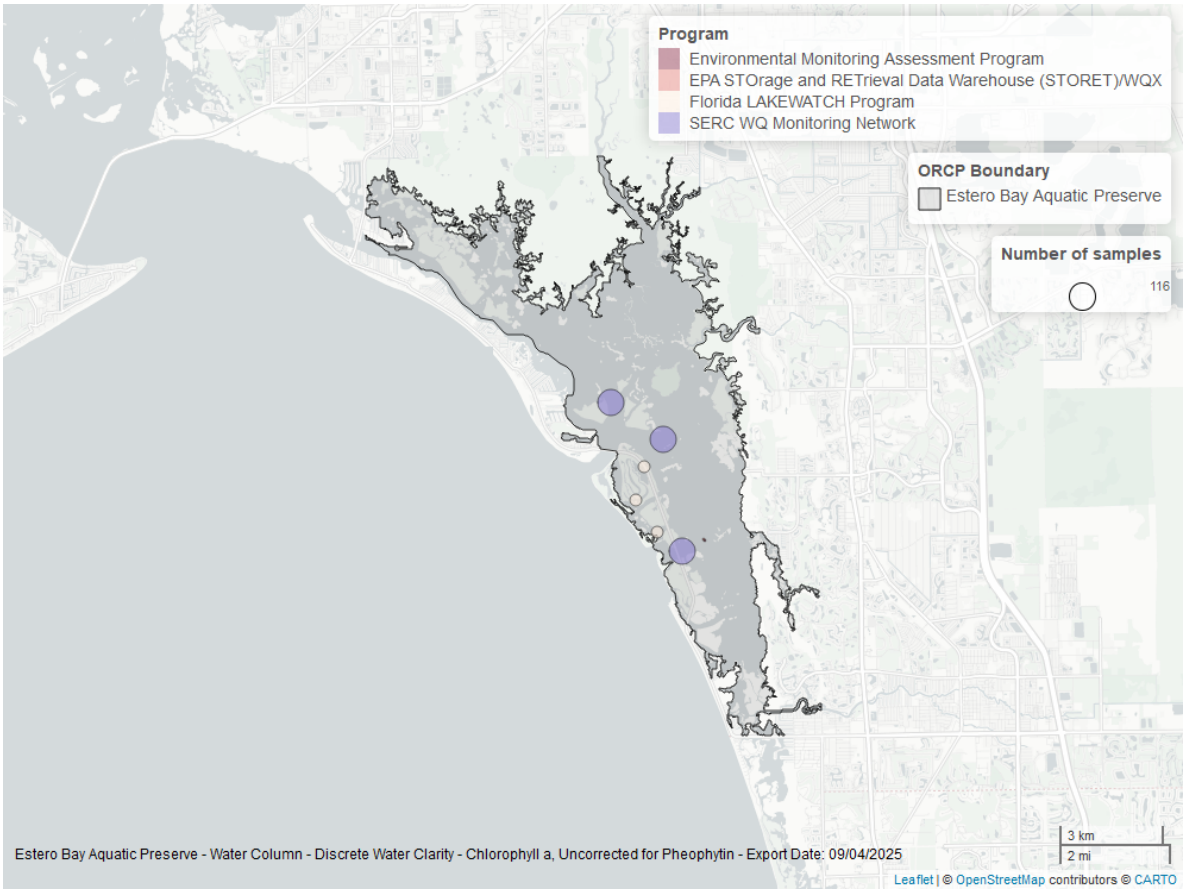

Figure 32: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Corrected for Pheophytin - Discrete

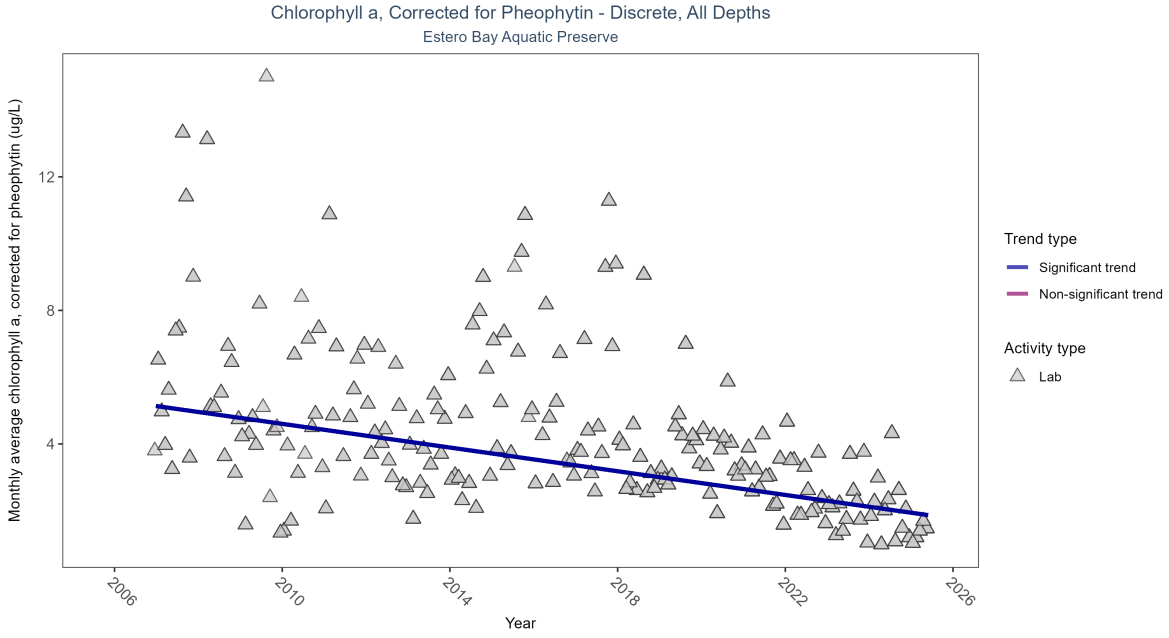

Figure 33: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 17: Seasonal Kendall-Tau Results for - Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	2450	20	2006 - 2025	2.58	-0.37436	5.3119	-0.17746	0

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.18 µg/L per year, indicating an increase in water clarity.

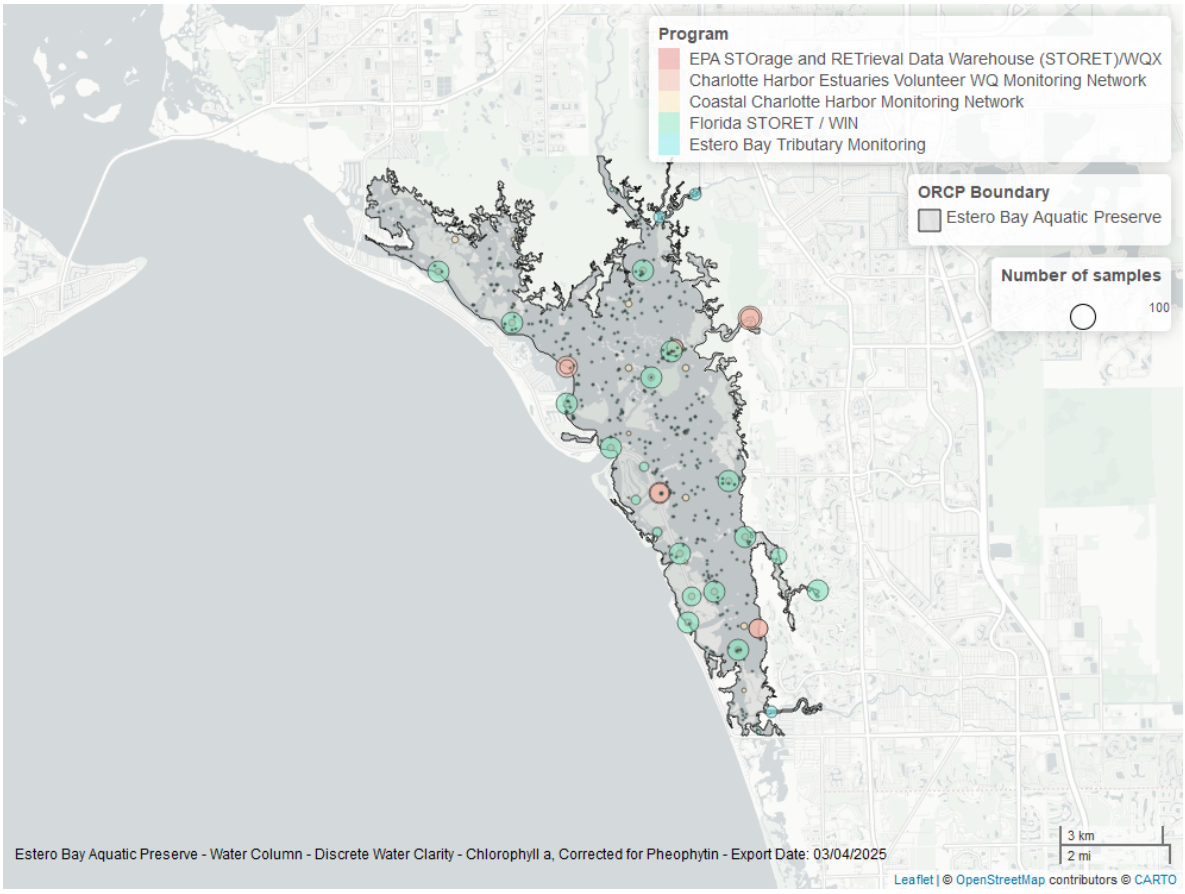

Figure 34: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Secchi Depth - Discrete

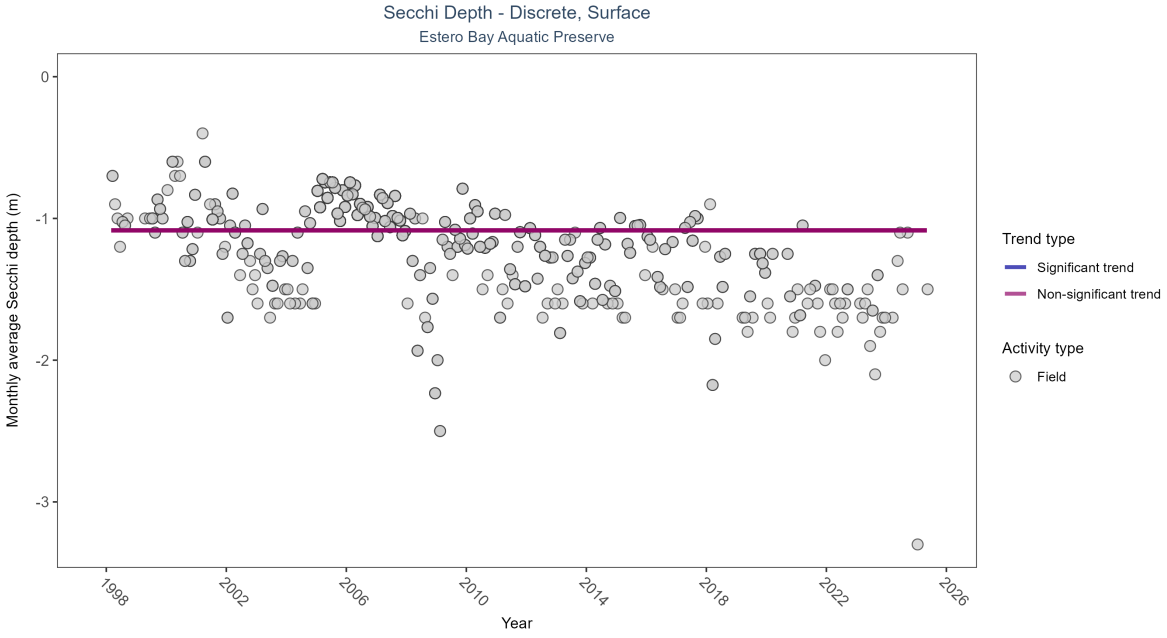

Figure 35: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 18: Seasonal Kendall-Tau Results for - Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	3310	28	1998 - 2025	-0.9	0.00759	-1.08371	0	0.9189

Secchi depth showed no detectable trend between 1998 and 2025.

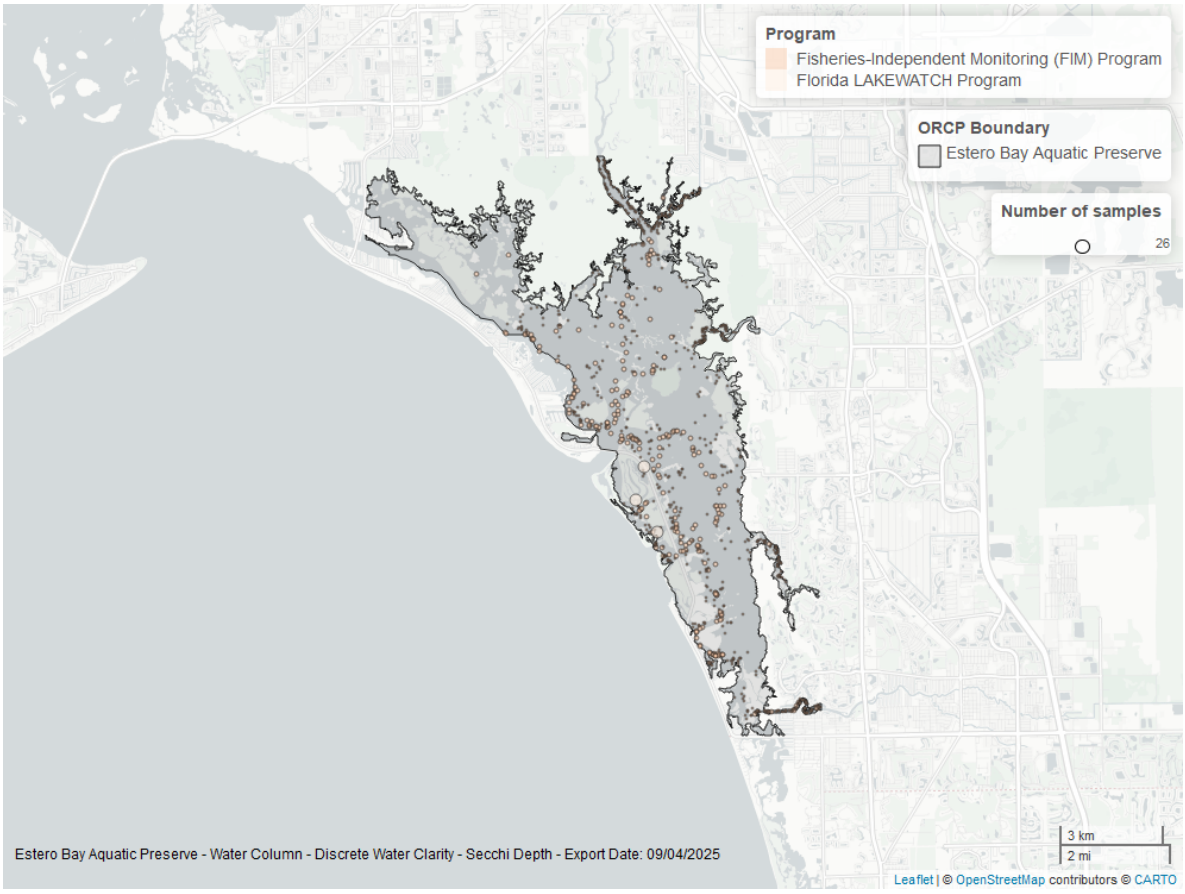

Figure 36: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Colored Dissolved Organic Matter - Discrete

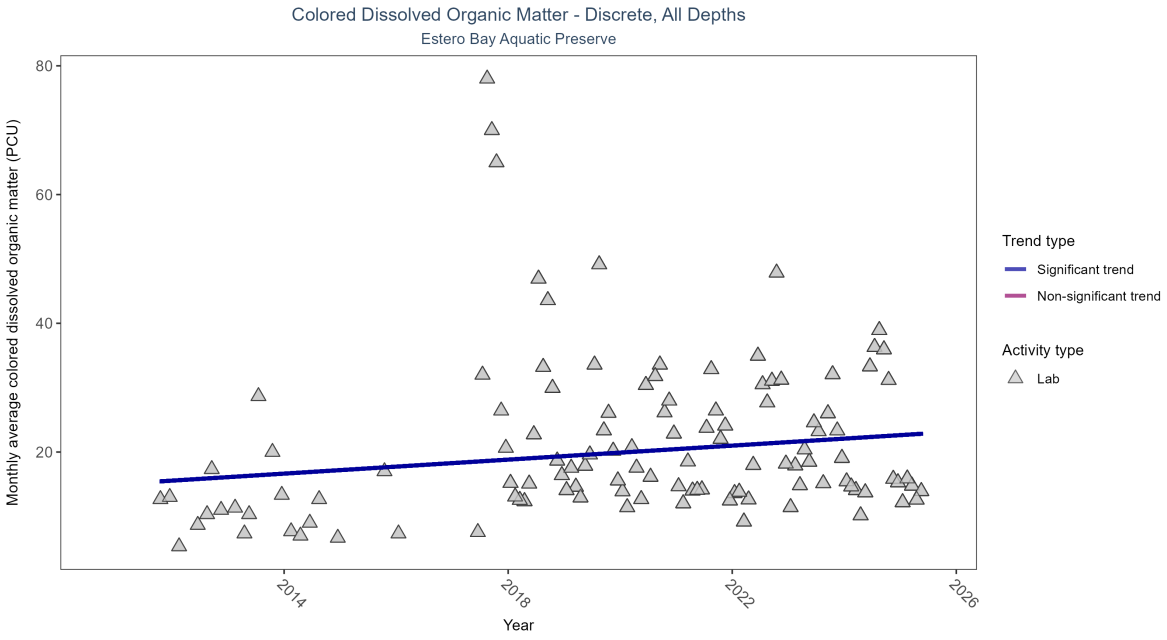

Figure 37: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

Table 19: Seasonal Kendall-Tau Results for - Colored Dissolved Organic Matter

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	2077	15	2011 - 2025	13.9	0.22634	15.01396	0.54378	0.001

Monthly average colored dissolved organic matter increased by 0.54 PCU per year, indicating a decrease in water clarity.

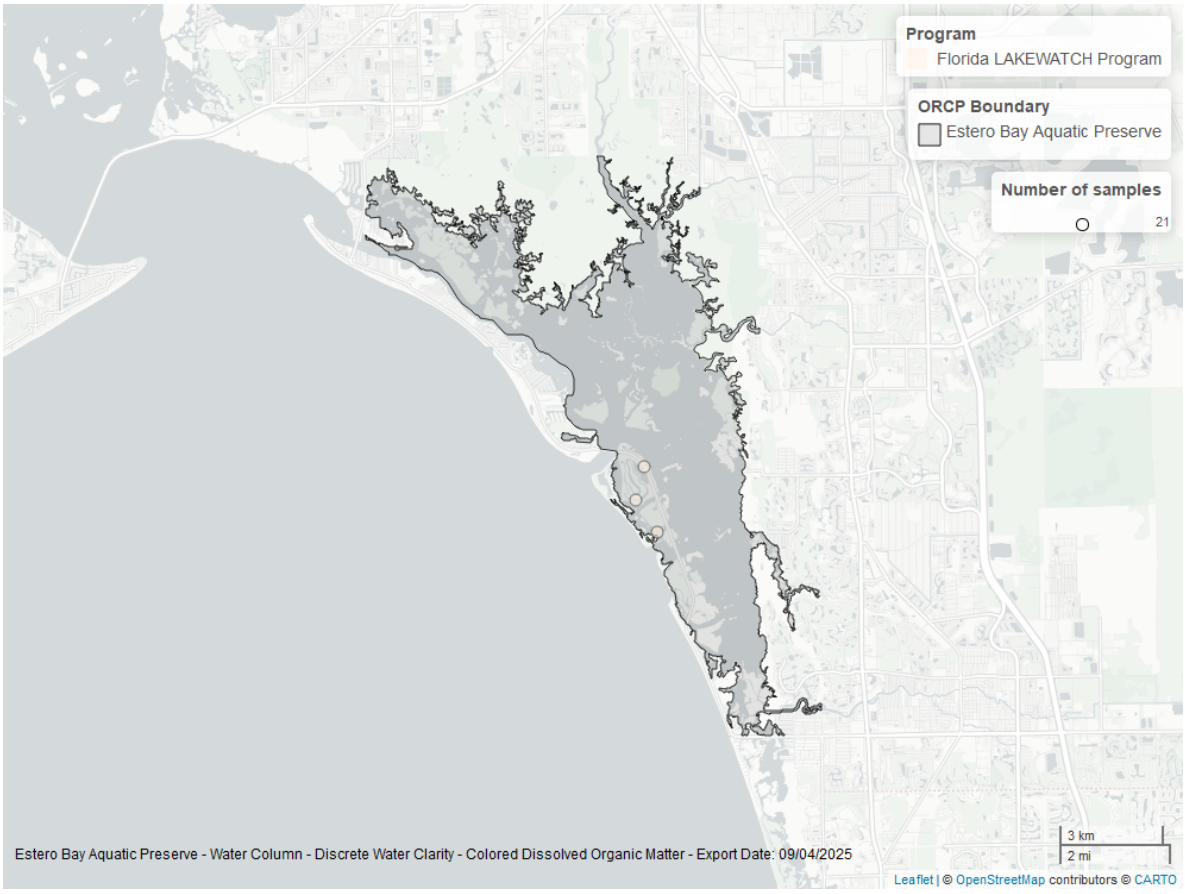

Figure 38: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.