16-1 Lake Seminole Sediment Removal Project Data Analysis Report

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Contents

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Introduction

The purpose of the Lake Seminole Sediment Removal Project was to remove 900,000 cubic yards of organic and nutrient enriched sediments from the bottom of Lake Seminole. The objectives of the project were to: (1) reduce nutrient concentrations and improve water quality in Lake Seminole; (2) reduce concentration of nutrient loads discharged from Lake Seminole to Long Bayou and Boca Ciega Bay, a segment of the Tampa Bay estuarine system; and (3) support the long-term recovery of seagrass coverage in Long Bayou and Boca Ciega Bay by improving estuarine water clarity.

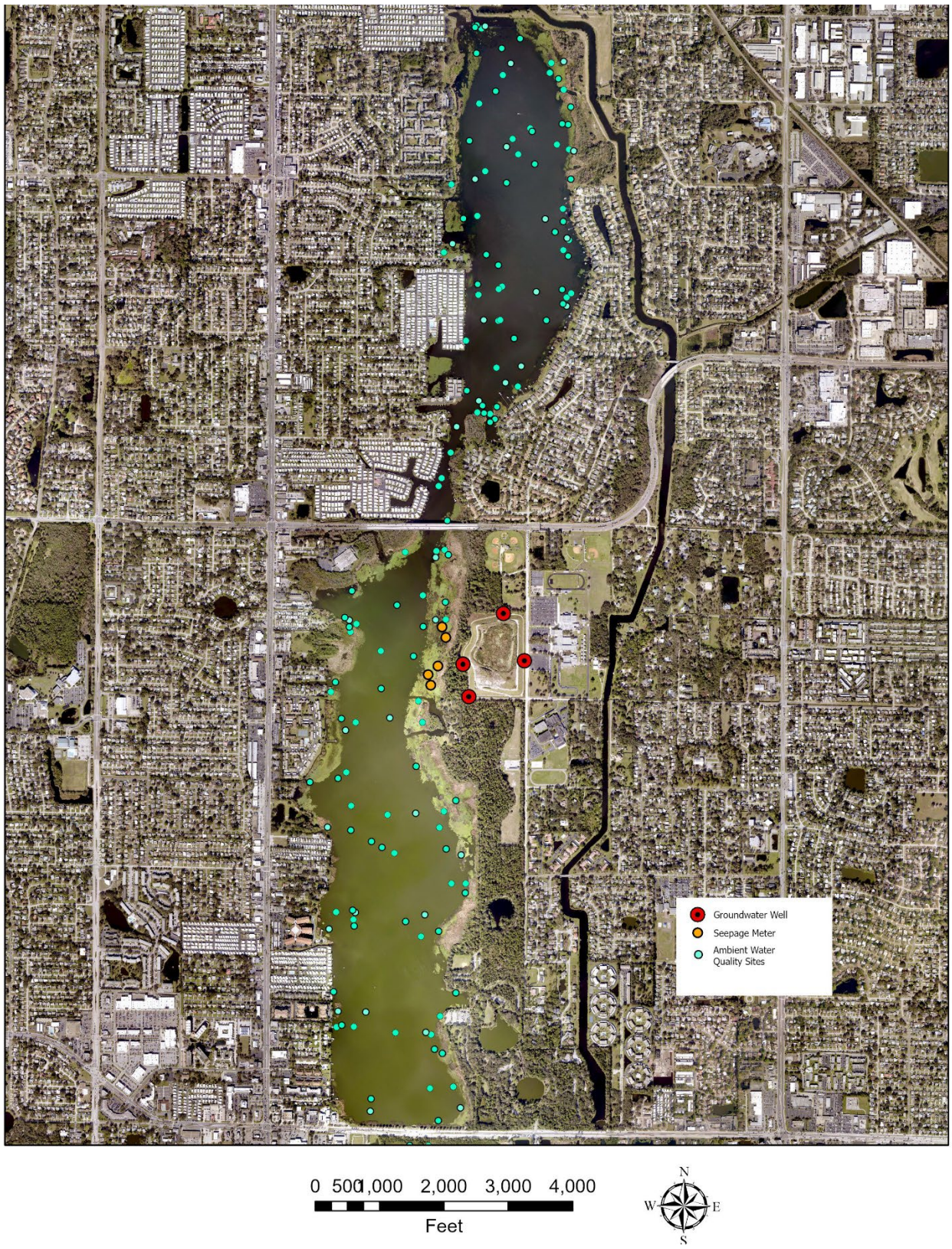
Between December 2019 and February 2021, dredging of approximately 915,000 cubic yards of organic sediments occurred throughout the lake basin. Over 660,00 cubic yards were removed from the north lobe and around 255,000 cubic yards were removed from the southern lobe of the lake. Based on pre-2020 nitrogen loadings to Boca Ciega Bay, it is estimated that sediments removed include 416 tons of nitrogen and 77 tons of phosphorus for more than a 55 percent source reduction. This load reduction estimate was calculated based on the actual volume dredged by area and the sediment nutrient concentration values. The sediment analysis was conducted during the sediment removal project design phase.

Pinellas County conducted several data collection regimes to study project outcomes. To determine in-lake water quality trends, samples from the northern and southern lobes of Lake Seminole were collected eight times per year for a total of 32 samples annually. Sample locations were determined using a stratified random design developed by Janicki Environmental (2003). Site locations for 2020 to 2024 project period are shown in Figure 1 and parameters listed in Table 1. To determine if there were any impacts on water quality from storing the dredged material, like nutrients seeping back into the lake via groundwater, four additional groundwater monitoring well sites, and 5 in-lake seepage meter sites were installed and monitored. Locations of well and seepage sites are shown in Figure 1.

Table 1. Lake Seminole water quality monitoring parameters

Water Quality Indicators	
Aluminum	Phytoplankton Taxonomy
Ammonia	Secchi Disk Depth
Chlorophyll-a, b, c, and Phaeophytin Concentration	Total Kjeldahl Nitrogen
Color	Total Nitrogen
Conductivity	Total Phosphorus
Dissolved Oxygen Concentration and % sat	Total Suspended Solids
Nitrite-Nitrate	Transmissivity (no longer collected after 2022)
Orthophosphate	Turbidity
pH	Water Temperature

Figure 1. Lake Seminole sampling locations (2020-2024)



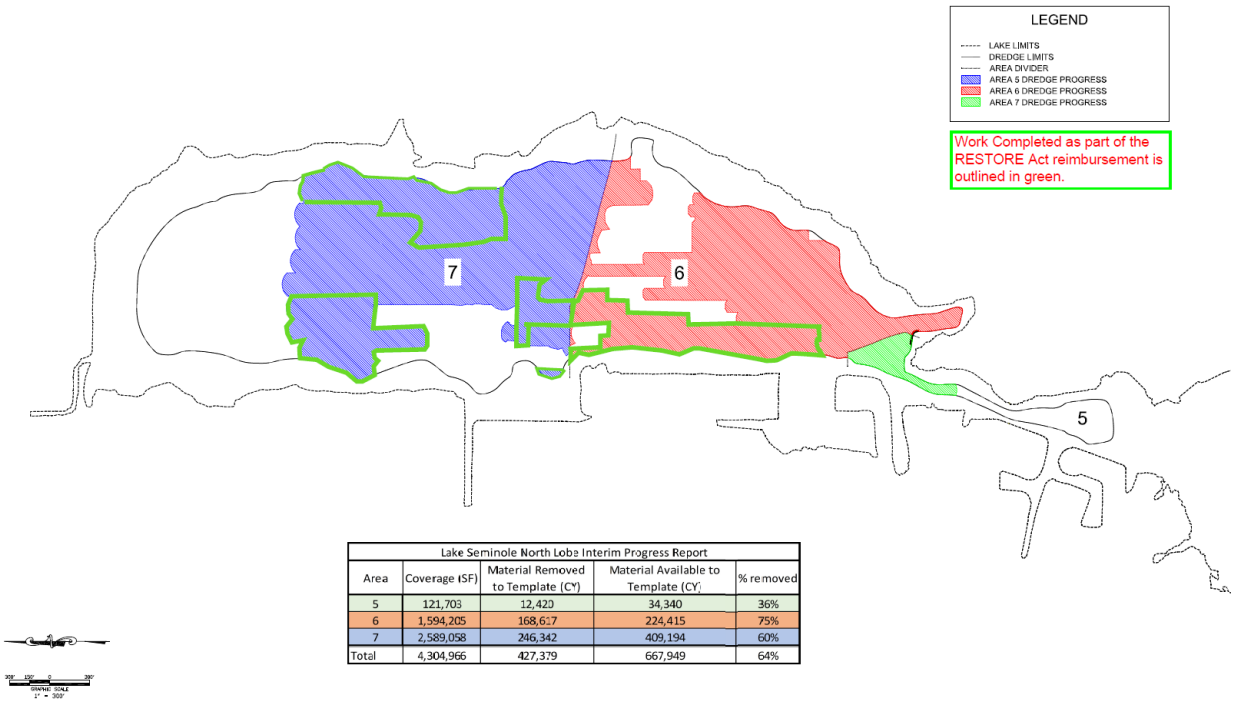
Monitoring & Trend Summary

In-lake water quality improved during the 2020-2024 monitoring period following sediment dredging activities. The *actual* chlorophyll-a (chl-a) concentration decreased throughout the lake when compared to the previous 2014 – 2018 four-year period. The *average* chl-a concentration of the lake decreased 63% compared to the 2005 Reasonable Assurance Plan (PBS&J 2007) levels and over 25% from the previous period. Total nitrogen (TN), total phosphorus (TP), and secchi water clarity depth show improved trends following sediment removal. The TN trend is decreasing by about 50%, TP is decreasing by about 30%, and secchi visual depth is improving by 76% when compared to 2005 levels. The following sections provide more detailed explanation of the data results collection during design, construction, and post construction for the Lake Seminole Sediment Removal Project.

Nutrient Reduction through Sediment Removal

The main goal of the Lake Seminole Sediment removal project was to reduce existing in-lake nitrogen and phosphorus sources, thus improving overall lake water quality. As part of the RESTORE funded effort, 101,011 cubic yards of organic sediments were removed from the north lobe of Lake Seminole (Figure 2). During dredging the total cubic yards removed is dependent on actual sediment type, composition, and/or depth. The funded work resulted in a removal of an estimated 51 tons of nitrogen and nearly 10 tons of phosphorus from Lake Seminole.

Figure 2. Map of dredging areas funded by RESTORE grant



Lake Seminole North Lobe Interim Progress Report				
Area	Coverage (SF)	Material Removed to Template (CY)	Material Available to Template (CY)	% removed
5	121,703	12,420	34,340	36%
6	1,594,205	168,617	224,415	75%
7	2,589,058	246,342	409,194	60%
Total	4,304,966	427,379	667,949	64%

Water Quality Trends

Ambient water quality goals for Lake Seminole are based on the chl-a and Trophic State Index (TSI) targets agreed upon in the 2005 Reasonable Assurance Plan (RAP) (PBS&J, 2007) and are expressed as annual means for chlorophyll-a (chl-a) and the Trophic State Index (TSI). The targets are 30 µg/L chl-a concentration and a TSI score of 60 or less. Geometric means for chl-a, total nitrogen (TN), total phosphorus (TP) was calculated for the lake from the Pinellas County Water Quality database and used for trend analysis.

Table 2.
Annual TSI and mean seasonal nutrient concentrations

Year	TSI	TN (mg/L)	TP (mg/L)	Chl-a (µg/L)
2005	91.3	3.34	0.11	128
2006	88.5	3.47	0.1	111
2007	91.2	4.59	0.34	103.3
2008	89.0	3.2	0.09	102.2
2009	89.4	3.77	0.08	132.1
2010	85.1	2.59	0.08	72.1
2011	78.9	1.97	0.07	77.2
2012	85.7	2.82	0.09	103
2013	83.5	2.19	0.08	78.6
2014	78.5	1.62	0.05	63.4
2015	78.9	1.89	0.06	62.9
2016	78.1	1.98	0.07	64.3
2017	82.1	2.19	0.09	82.1
2018	79.3	2.04	0.07	68.9
2019	76.0	1.73	0.08	56.4
2020	77.2	1.88	0.10	60.7
2021	73.3	1.63	0.08	50.7
2022	74.0	1.83	0.07	53.3
2023	73.2	1.93	0.07	43.6
2024	70.5	1.68	0.06	38.96

Table 3.
Annual geometric means for nutrients

Year	Chl-a (µg/L)	TN (mg/L)	TP (mg/L)
2005	117.7	3.25	0.10
2006	96.3	3.30	0.09
2007	99.3	3.74	0.13
2008	93.6	3.13	0.09
2009	120.2	3.66	0.07
2010	69.4	2.55	0.07
2011	53.5	1.90	0.07
2012	94.0	2.67	0.07
2013	75.8	1.92	0.06
2014	61.1	1.55	0.05
2015	60.6	1.85	0.06
2016	57.4	1.90	0.07
2017	74.7	2.12	0.09
2018	64.0	1.99	0.07
2019	52.0	1.70	0.08
2020	53.9	1.81	0.09
2021	46.5	1.54	0.08
2022	45.9	1.69	0.07
2023	39.5	1.85	0.07
2024	36.8	1.65	0.06

*Laboratory QA/QC problems resulted in several qualified results that were removed for this calculation.

For the 2019-2024 period, during-dredge and post-dredge activities, TN decreased by about 9%, TP increased by about 18% and Secchi depth improved by about 42%. These TN and TP concentrations and secchi depth changes are less pronounced when comparing to the previous 2014-2018 reporting period. When comparing to the 2005 RAP values, these TN, TP, and secchi depth analysis indicate improved trends with TN decreasing by about 50%, TP decreasing by about 30%, and secchi depth improving by ~76%.

The Florida Department of Environmental Protection (FDEP)'s Impaired Waters Rule assessments include data from Pinellas County and FDEP for verified periods. For the entire lake the chlorophyll a, nutrients, and TSI trends show decreases, or improving water quality, following the sediment removal project.

Figure 3. Lake Seminole TSI (2005 to 2024)

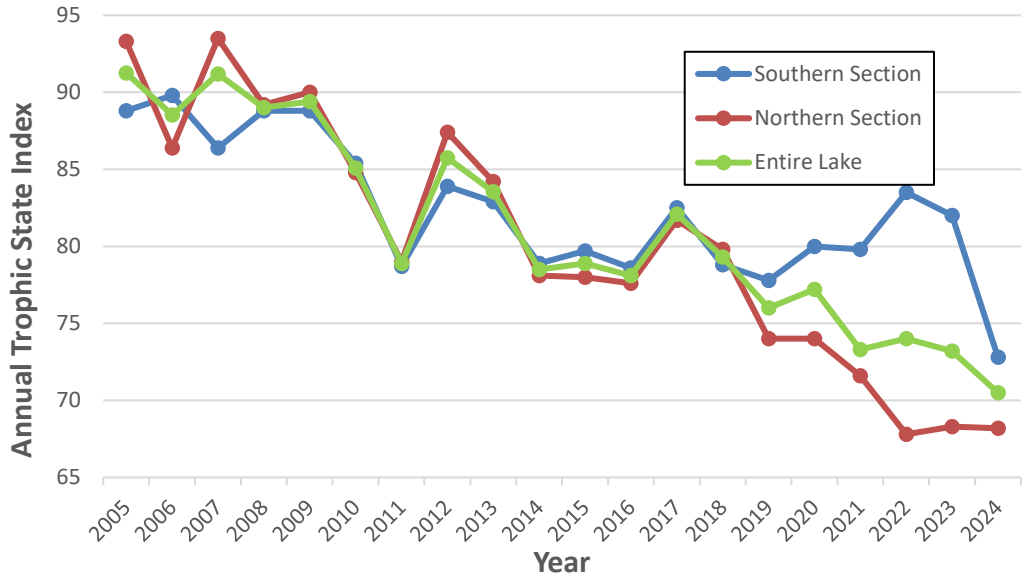
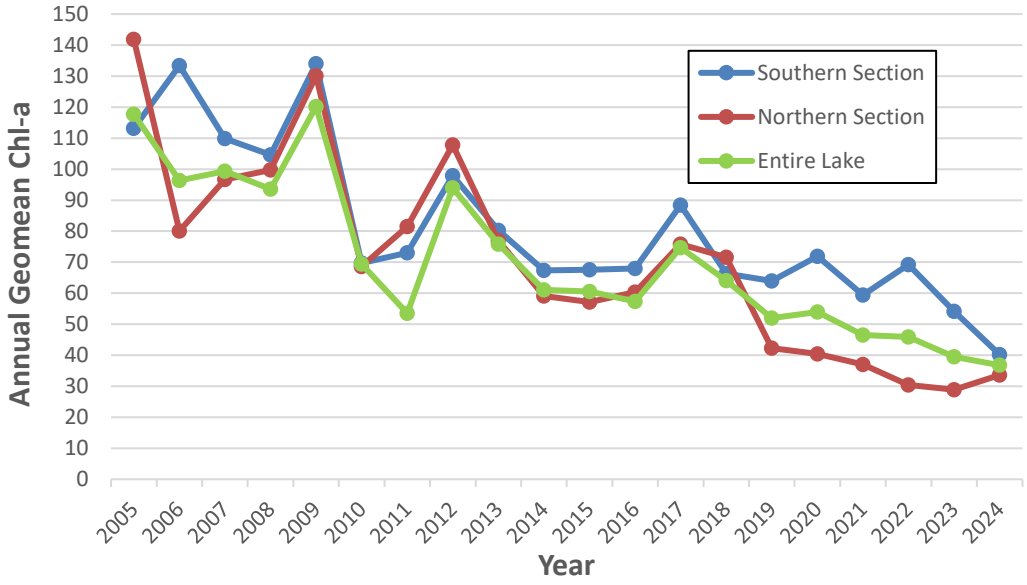
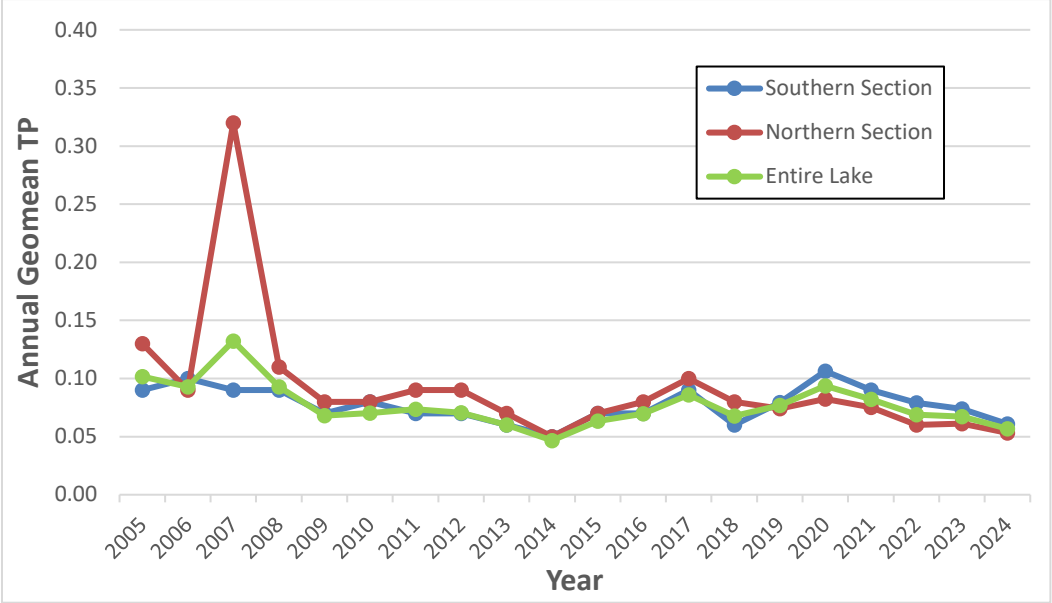


Figure 4. Lake Seminole Chlorophyll-a annual geometric mean (2005 to 2024)



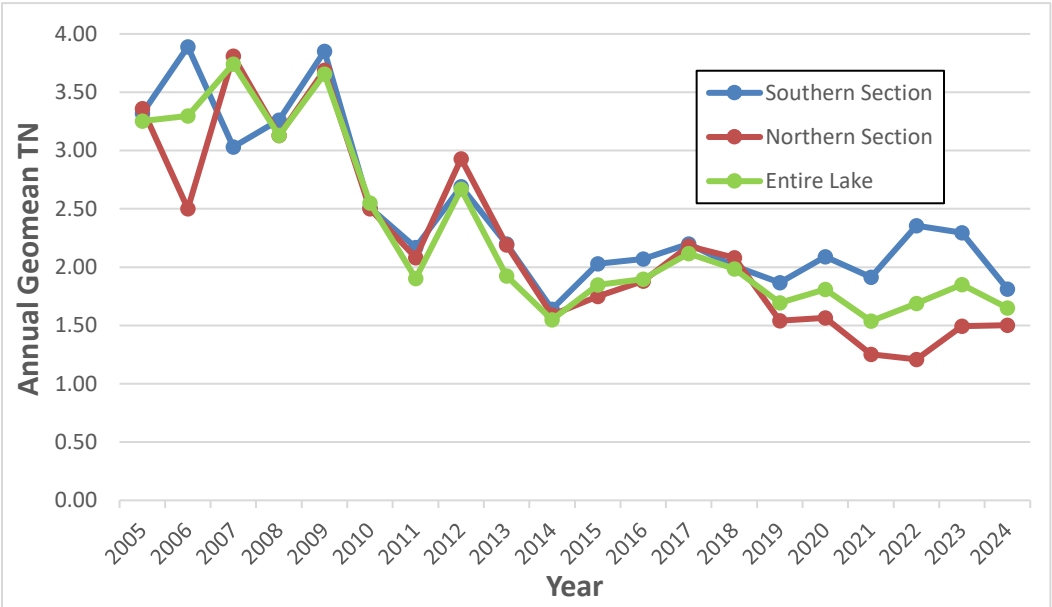
Chlorophyll-a (chl-a) decreased in the lake when compared to the previous reporting period. Average chl-a concentration of the lake decreased 63% from 2005 levels and more than 25% from the previous reporting period.

Figure 5. Lake Seminole Total Phosphorus annual geometric mean (2005 to 2024)



For the 2019-2024 period, during-dredge and post-dredge activities, an increase in TP concentration was observed. All TP results were above 0.076 mg/L during the project period due to observed concentration spikes in 2019-2021 and are likely due to dredging activities suspending particulates from December 2019 until February 2021. Once the dredging activities were completed, and sediments were not being regularly disturbed, the TP values returned to below 0.070 mg/L.

Figure 6. Lake Seminole Total Nitrogen annual geometric mean (2005 to 2024)



Trends and results between the northern and southern lake lobes were compared and graphed in Figures 4 – 6 for chlorophyll a, nutrients, and TSI. The large decreases in nutrient and chl-a concentrations in the northern lobe are likely due to the removal of over 650,000 cubic yards of organic sediments from the lake as part of the dredging effort. Average secchi depth measurements in the northern lobe improved by double the depth from 0.2m to 0.4m within months of dredging completion. Recent water quality trends were more pronounced in the northern lobe of the lake with about a 45% decrease in Chlorophyll-a values compared to the previous 2014-2018 period, or improving from an average of 65 ug/L during 2014-2018 to an average of 36 ug/L over 2019-2023. The TN and TP concentrations show similar, though less pronounced, decreases by ~25% and ~7% in the northern lobe between the two time periods. The decrease in chl-a trend in the southern lobe was not as pronounced with only an 11% decrease between periods. The southern lobe of the lake did not have nearly as much dredging done, only about 240,000 cubic yards, and we did not see the same response.

Additionally, color data indicates a long–term geometric mean of 37 PCUs for the planning period from 2003 to 2024. Based on this assessment, the Florida Numeric Nutrient Standards lake classification for Lake Seminole is "Color > 40 PCU", and coincides with the numeric nutrient criteria of 20 µg/L for chl-a, 1.27 mg/L for TN, and 0.05 mg/L for TP.

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	**20 µg/L**	**0.05 mg/L**	**1.27 mg/L**	**0.16 mg/L[1]**	**2.23 mg/L**
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	**20 µg/L**	**0.03 mg/L**	**1.05 mg/L**	**0.09 mg/L**	**1.91 mg/L**
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	**6 µg/L**	**0.01 mg/L**	**0.51 mg/L**	**0.03 mg/L**	**0.93 mg/L**

Chl-a, TP, and TN values exceeded criteria every year during the planning period; however, Pinellas County data shows a decreasing trend in nutrients over the past 20 years as illustrated through time series analyses.

Water Quality Time Series Analysis

A time series trend analysis for Pinellas County data collected from 2003 to 2023 was conducted using the seasonal Kendall Tau Test for Trend. This analysis considered both seasonality and autocorrelation. Results for Lake Seminole are displayed in Table 4. This analysis detected improvements in nearly all water quality parameters, with statistically significant (p-value ≤ 0.05) decreasing trends in chl-a, TN, TP, turbidity, and total suspended solids (TSS) and increasing trends in Secchi disk depth and transmissivity water clarity for northern and southern portions of the lake (Janicki 2023).

In comparison to the other 61 monitoring stations in Pinellas County waterbodies, only six others had decreasing trends in chl-a, 14 other sites had decreasing trends in TN, 15 other stations had decreasing trends in TP, and only one site, other than the Lake Seminole north lobe, in Pinellas County exhibited decreasing trends in all three nutrient parameters (Janicki 2023). This indicates that the water quality improvement in Lake Seminole is not common across the County and is likely the result of ongoing management actions outlined in the 2005 Reasonable Assurance Plan (PBS&J 2007).

Table 4. Results of Lake Seminole Kendall Tau trend analysis 2003-2023.

Lake Segment	Parameter	Statistically Significant Trend Direction
SA	Chl-a	Decreasing
SB	Chl-a	Decreasing
SA	Secchi disk	Increasing
SB	Secchi disk	Increasing
SA	Transmisivity	Increasing
SB	Transmisivity	Increasing
SA	Turbidity	Decreasing
SB	Turbidity	Decreasing
SA	TSS	Decreasing
SB	TSS	Decreasing
SA	DO (%Sat)	No trend
SB	DO (%Sat)	No trend
SA	TN	Decreasing
SB	TN	Decreasing
SA	TP	Decreasing
SB	TP	No trend

Groundwater Quality Trends

To help determine the influence of any groundwater nutrient inputs to the lake, especially near the Dredge Materials Management Area (DMMA), Pinellas County installed five groundwater monitoring well sites and four in-lake seepage meter sites. For the first two years of collection (2019-2020), the well sites were sampled quarterly. For 2021-2024 samples were collected every 6 months. The revised sampling frequency occurred because the site was used as a dewatering area for surface discharge and percolation which added to any measured groundwater quantity and quality during the active dredging period from December 2019 through February 2021. In-lake seepage meter sample collection is dependent on the volume of groundwater inflow captured by the meter and varies by site and over the course of the study.

Overall, there were no significant trends between pre and post dredge conditions in water quality in the groundwater well or lake seepage collections as shown in Tables 5 and 6. This indicates that storing the organic sediments adjacent to the lake is not having an affect on the nutrient concentration of groundwater coming into the lake in that area. For the groundwater wells, the years following use of the DMMA, 2022 through 2024, had lower TKN, TP, and OP values than in 2019, the year before the DMMA went active (Table 5).

Table 5. Annual Mean Nutrient Values from Groundwater Wells

Year	Mean TKN (mg/L)	Mean TP (mg/L)	Mean OP (mg/L)
2019	1.35	0.35	0.27
2020	1.19	0.25	0.21
2021	1.47	0.27	0.22
2022	1.27	0.23	0.13
2023	1.25	0.18	0.14
2024	1.08	0.25	0.16

Seepage results varied over time with no clear trend (Table 6, Figures 9 and 10). However, a slight increase in quantity and nutrient concentration was observed in 2021 compared to the previous year (Table 6).

Table 6. Seepage annual mean results

Year	Mean Seepage ml/Day	Mean TKN (mg/L)	Mean TP (mg/L)	Mean OP (mg/L)
2019	**61.68**	**2.69**	**0.21**	**0.02**
2020	**62.94**	**2.70**	**0.25**	**0.06**
2021	**114.90**	**2.90**	**0.26**	**0.05**

The increase in volume is slight and would likely not have any effect on the lake. The limited amount of seepage into the lake is not surprising due to the large organic sediment deposits along the shoreline, which have poor permeability and can affect the distribution of seepage into the lake.

Figure 7. Mean TKN from groundwater well sampling during the study period

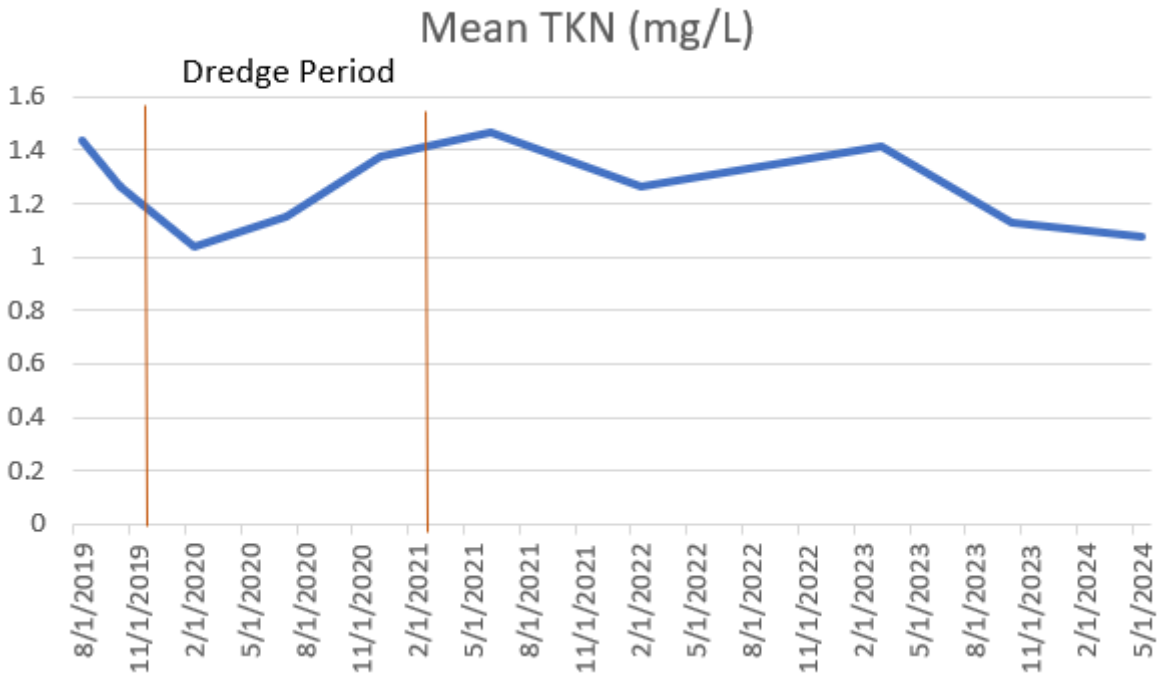


Figure 8. Mean TP from groundwater well sampling during the study period

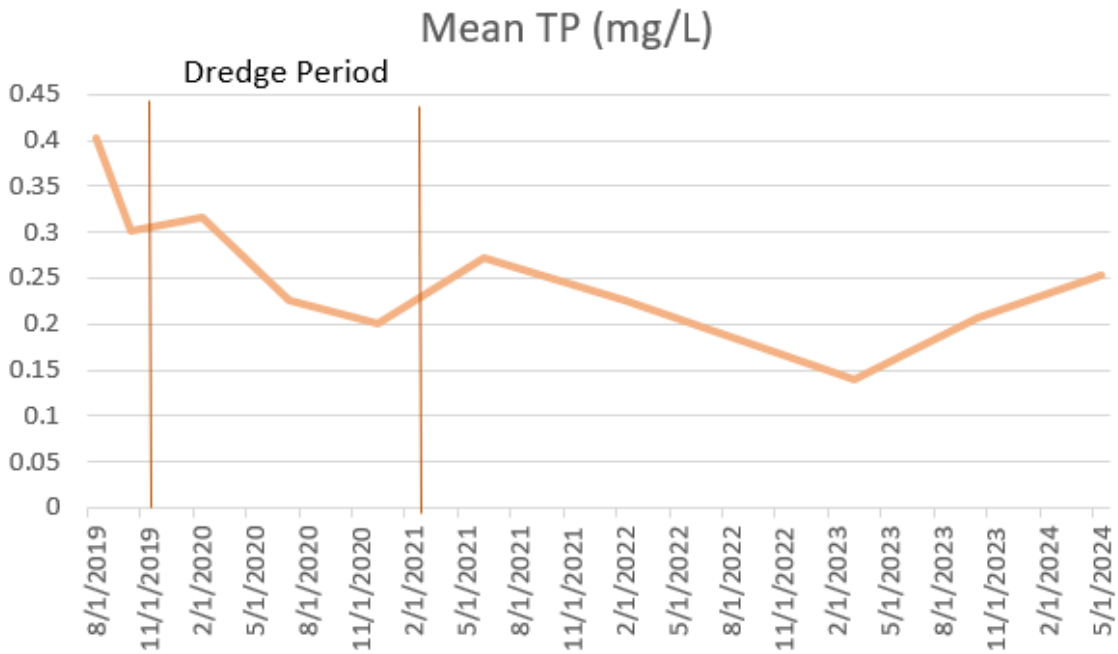


Figure 9. Seepage mean TKN results.

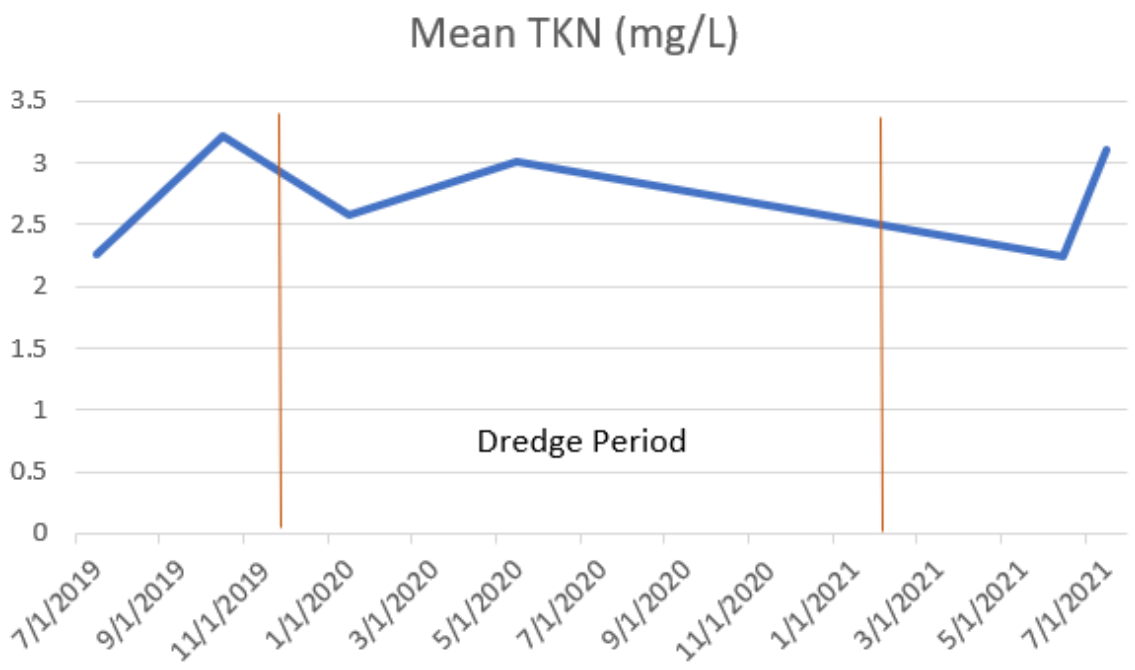
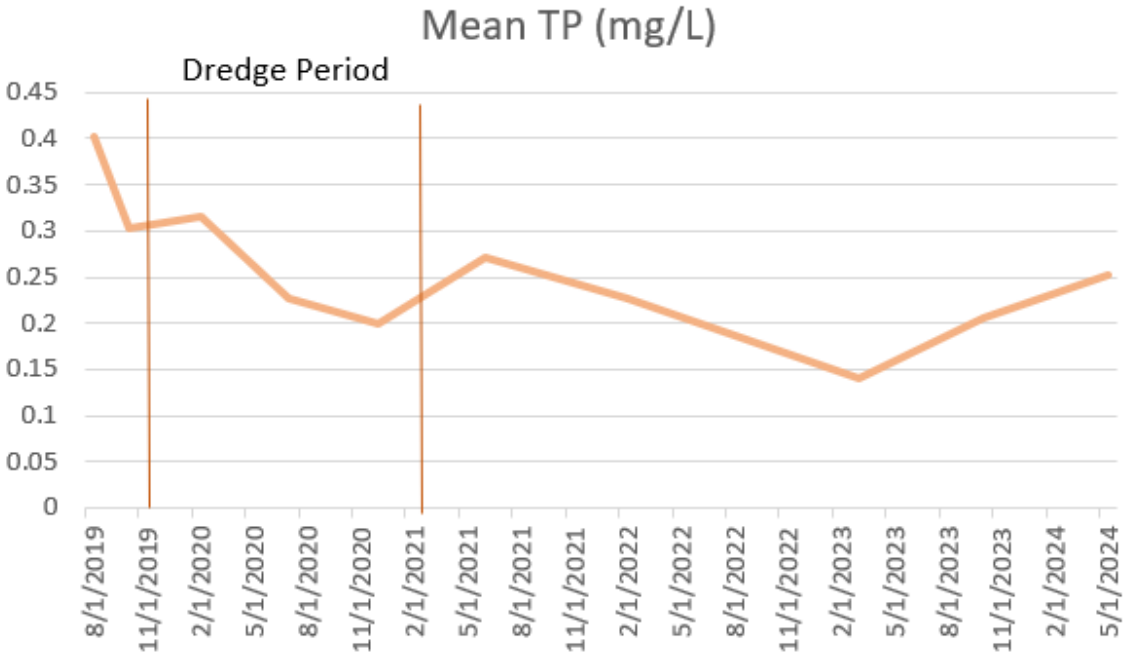


Figure 10. Seepage mean TP results.



Data Availability

Routine surface water quality results and trends associated with this effort will be made available at Pinellas County's Division of Environmental Management Water Quality dashboard which can be found at https://pcdem.shinyapps.io/dashboard/.

The following pages provide the groundwater monitoring result data for the four Lake Seminole sites, LSD IW-1, LSD MW-2, LSD MW-3, and LSD MW-4 and the five seepage sites for the duration of the project monitoring period.

Site	Coll Date	Coll Time	TKN (mg/L as N)	TKN_Flag	NH3 (mg/L as N)	NH3_Flag	Nox (mg/L as N)	NOX-Flag	Total P (mg/L as P)	TP_Flag	Dissd oP (mg/L as P)	OP_Flag	Dissd Al (mg/L)	DAL_Flag	AL (mg/L)	AL_Flag	Ar (mg/L)	Ar_Flag	Cr (mg/L)	Cr_Flag	PB (mg/L)	PB_Flag	Work Order
LSD-IW-1	8/8/2019	10:15	0.88		0.22		0.01	U	0.09		0.04	I	0.032	I	0.641		0.01	U	0.003	I	0.005	U	1901617
LSD-IW-1	10/24/2019	9:19	0.96		0.29		0.04	I	0.33		0.29		0.052	I	0.079		0.01	U	0.002	I	0.005	U	1902184
LSD-IW-1	2/27/2020	9:40	0.85		0.32		0.02	I	0.26		0.2		0.022	I	0.022	I	0.01	U	0.001	I	0.005	U	2000416
LSD-IW-1	7/8/2020	10:10	1.15		0.35		0.01	I	0.47		0.42		0.023	I	0.028	I	0.01	U	0.003	I	0.005	U	2001314
LSD-IW-1	12/2/2020	11:43	0.56		0.26		0.01	I	0.19		0.17		0.02	U	0.021	I	0.01	U	0.001	I	0.005	U	2002361
LSD-IW-1	6/28/2021	10:40	0.62		0.23		0.01	U	0.19		0.15		0.088				0.01	U	0.001	U	0.005	U	2101308
LSD-IW-1	2/24/2022	9:39	0.59		0.22		0.01	U	0.2		0.08		0.116		0.124		0.01	U	0.0011	I	0.005	U	2200355
LSD-IW-1	3/29/2023	11:39	0.53		0.2		0.01	U	0.18		0.15		0.0535	I	0.0699		0.01	U	0.001	U	0.005	U	2300706
LSD-IW-1	10/18/2023	11:19	0.53		0.25		0.01	U	0.18		0.15		0.0539	I	0.0493	I	0.01	U	0.001	U	0.005	U	2302608
LSD-MW-1	8/8/2019	9:35	2.26		0.48		0.01	U	1.39		1.36		1.07		1.16		0.01	U	0.003	I	0.005	U	1901617
LSD-MW-1	10/24/2019	9:52	2.62		0.91		0.1		0.94		0.92		0.966		1.04		0.01	U	0.002	I	0.005	U	1902184
LSD-MW-1	2/27/2020	10:10	1.77		0.59		0.01	I	0.88		0.81		0.099		0.099		0.01	U	0.005		0.005	U	2000416
LSD-MW-1	7/8/2020	9:32	0.62		0.26		0.01	U	0.19		0.16		0.02	U	0.02	U	0.01	U	0.001	U	0.005	U	2001314
LSD-MW-1	12/2/2020	11:05	0.95		0.34		0.02	I	0.38		0.36		0.038	I	0.56		0.01	U	0.003	I	0.005	U	2002361
LSD-MW-1	6/28/2021	10:30	1.9		0.36		0.01	U	0.77		0.68		0.174				0.01	U	0.003	I	0.005	U	2101308
LSD-MW-1	2/24/2022	9:41	0.91		0.3		0.01	U	0.43		0.22		0.192		0.187		0.01	U	0.0032	I	0.005	U	2200355
LSD-MW-1	3/29/2023	11:20	8.78		6.51		0.15		1.17		1.07		0.131		0.108		0.01	U	0.0027	I	0.005	U	2300706
LSD-MW-1	10/18/2023	10:56	0.98		0.43		0.01	U	0.38		0.28		0.11		0.0984		0.01	U	0.0021	I	0.005	U	2302608
LSD-MW-2	8/8/2019	12:54	1.55		0.15		0.18		0.25		0.01	U	2.14		7.09		0.01	U	0.015		0.005	U	1901617
LSD-MW-2	10/24/2019	11:43	0.88		0.16		0.75		0.08		0.02	I	1.36		1.53		0.01	U	0.003	I	0.005	U	1902184
LSD-MW-2	2/27/2020	10:40	0.94		0.33		0.01	U	0.24		0.19		0.128		0.167		0.01	U	0.004	I	0.005	U	2000416
LSD-MW-2	7/8/2020	10:42	2.2		1.42		0.01	U	0.11		0.08		0.282		0.749		0.01	U	0.003	I	0.005	U	2001314
LSD-MW-2	12/2/2020	10:29	1.11		0.24		0.01	U	0.21		0.19		0.139		0.146		0.01	U	0.003	I	0.005	U	2002361
LSD-MW-2	6/28/2021	9:50	2.2		1.09		0.02	I	0.08		0.05		0.329				0.01	U	0.002	I	0.005	U	2101308
LSD-MW-2	2/24/2022	11:13	2.46		1.56		0.01	U	0.08		0.05		0.416		0.547		0.01	U	0.0017	I	0.005	U	2200355
LSD-MW-2	3/29/2023	10:44	2.41		1.33		0.02	I	0.06		0.04		0.404		0.342		0.01	U	0.0016	I	0.005	U	2300706
LSD-MW-2	10/18/2023	10:20	1.45		0.64		0.01	I	0.09		0.04	I	0.21		0.625		0.0114	I	0.0012	I	0.005	U	2302608
LSD-MW-3	8/8/2019	12:03	0.86		0.18		0.01	U	0.22		0.05		0.768		2.16		0.01	U	0.007	I	0.005	U	1901617
LSD-MW-3	10/24/2019	11:10	0.79		0.22		0.03	I	0.04		0.01	I	0.549		0.897		0.01	U	0.003	I	0.005	U	1902184
LSD-MW-3	2/27/2020	11:25	1.07		0.19		0.01	U	0.07		0.05		0.578		0.78		0.01	U	0.004	I	0.005	U	2000416
LSD-MW-3	7/8/2020	8:27	0.89		0.38		0.01	U	0.06		0.05		0.442		0.493		0.01	U	0.004	I	0.005	U	2001314
LSD-MW-3	12/2/2020	9:57	1.69		0.84		0.01	U	0.08		0.06		0.572		0.638		0.01	U	0.002	I	0.005	U	2002361
LSD-MW-3	6/28/2021	11:50	1.5		0.24		0.01	U	0.07		0.02	I	0.887				0.01	U	0.004	I	0.005	U	2101308
LSD-MW-3	2/24/2022	10:35	1.34		0.45		0.01	U	0.06		0.03	I	0.824		0.969		0.01	U	0.0026	I	0.005	U	2200355
LSD-MW-3	3/29/2023	12:40	1.55		0.72		0.01	U	0.04		0.02	I	0.67		0.494		0.01	U	0.0014	I	0.005	U	2300706
LSD-MW-3	10/18/2023	12:16	1.83		1.12		0.01	U	0.05		0.03	I	0.717		0.806		0.0101	I	0.0014	I	0.005	U	2302608
LSD-MW-4	8/8/2019	11:18	1.62		0.49		0.01	U	0.06		0.01	U	3.84		4.36		0.01	U	0.002	I	0.005	U	1901617
LSD-MW-4	10/24/2019	10:38	1.07		0.23		0.04	I	0.12		0.01	I	4.5		5.58		0.01	U	0.001	I	0.005	U	1902184
LSD-MW-4	2/27/2020	12:00	0.55		0.18		0.02	I	0.13		0.07		0.058		0.278		0.01	U	0.002	I	0.005	U	2000416
LSD-MW-4	7/8/2020	8:59	0.9		0.32		0.01	U	0.3		0.25		0.097		0.156		0.01	U	0.003	I	0.005	U	2001314
LSD-MW-4	12/2/2020	12:15	2.59		1.68		0.01	I	0.14		0.13		0.105		0.118		0.01	U	0.002	I	0.005	U	2002361
LSD-MW-4	6/28/2021	11:25	1.13		0.25		0.01	U	0.25		0.19		0.441				0.01	U	0.004	I	0.005	U	2101308
LSD-MW-4	2/24/2022	10:16	1.03		0.28		0.01	U	0.36		0.26		0.194		0.25		0.01	U	0.0044	I	0.005	U	2200355
LSD-MW-4	3/29/2023	12:10	1.17		0.39		0.01	U	0.28		0.24		0.177		0.169		0.01	U	0.0034	I	0.005	U	2300706
LSD-MW-4	10/18/2023	11:46	0.84		0.34		0.01	U	0.33		0.28		0.123		0.17		0.0173	I	0.0041	I	0.005	U	2302608

Site	Lat	Lon	Date	Disconnection Time	Reconnection Time	Volume Removed from Bag (ml)	pH	Conductivity (ms/cm)	DO (mg/L)	DO %	Salinity (PPT)	Temp (C)	OP	TP	TKN	NH3	Nox	Color	SO4	Ca	Mg	Comments
Seepage 1	28.61342	-81.16032	7/18/2019	1029	1036	9100	7.29	520.0	4.27	56.80	0.23	30.38	0.01	0.21	1.25	0.01	0.08	50	-	-	-	Lat/Lon provided by consultant will verify coordinates next time out.
Seepage 2	27.8606	-82.77861	7/18/2019	1054	1102	4350	7.07	349.0	3.39	44.80	0.02	30.21	0.01	0.3	2.69	0.06	0.01	25	-	-	-	
Seepage 3	27.85937	-82.77893	7/18/2019	1116	1122	6900	6.75	424.0	2.59	34.00	0.19	29.82	0.01	0.04	1.34	0.01	0.01	27	-	-	-	
Seepage 4	27.85898	-82.77945	7/18/2019	1131	1137	2800	6.60	336.0	2.84	37.80	0.15	30.85	0.04	0.43	3.24	0.26	0.01	20	-	-	-	
Seepage 5	27.85853	-82.77931	7/18/2019	1142	1149	6850	6.46	432.0	1.96	26.70	0.19	31.59	0.01	0.13	2.79	0.03	0.01	27	-	-	-	
Lake Reference			7/18/2019	-	-		8.79	434.0	9.16	124.20	0.19	31.62										
Seepage 1			1/30/2020	943	947	7830	7.08	444.4	5.98	59.20	-	14.87	0.01	0.12	2.51	0.51	0.08	25	14	37.6	7.42	
Seepage 2	27.8606	-82.77861	1/30/2020	1006	1009	5725	7.30	498.0	6.54	65.40	-	15.17	0.17	0.28	3.16	1.34	0.65	27	22	36.9	8.88	
Seepage 3	27.85937	-82.77893	1/30/2020	1034	1042	4130	7.41	330.3	8.00	80.40	-	15.53	0.01	0.26	2.17	0.12	0.14	30	10	29.9	6.16	
Seepage 4	27.85898	-82.77945	1/30/2020	1112	1117	11100	7.18	526.0	5.32	53.5	-	15.59	0.04	0.18	1.66	0.02	0.83	32	22	42.1	9.24	
Seepage 5	27.85853	-82.77931	1/30/2020	1134	1138	8650	7.16	575.0	4.52	45.6	-	15.72	0.1	0.38	3.36	1.05	0.37	32	20	39.3	10.5	
Seepage 1			10/10/2019	1005	1025	4200	7.89	272.1	4.4	54	0.13	26.1	0.01	0.1	1.58	0.01	0.01	20	11	28.9	2.98	
Seepage 2	27.8606	-82.77861	10/10/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bag ripped by Alligator
Seepage 3	27.85937	-82.77893	10/9/2019	1117	1119	5500	7.41	318	6.08	76.2	0.13	27.2	0.02	0.07	1.79	0.04	0.01	47	15	32.3	3.9	
Seepage 4	27.85898	-82.77945	10/9/2019	1100	112	2000	7.4	131.6	3.49	43.9	0.06	26.9	0.05	0.43	4.32	0.06	0.01	15	6	16.2	1.46	
Seepage 5	27.85853	-82.77931	10/9/2019	1026	1042	2500	7.31	278.2	3.45	43.8	0.15	27	0.02	0.21	5.19	0.53	0.01	20	16	32.6	3.33	
Seepage 1			5/12/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Could not access due to dredging equipment
Seepage 2	27.8606	-82.77861	5/12/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Could not access due to dredging equipment
Seepage 3	27.85937	-82.77893	5/12/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Could not access due to being inside dredge project turbidity boom
Seepage 4	27.85898	-82.77945	5/12/2020	10:24	10:28	5550	7.48	840	4.25	51.7	0.41	25	0.1	0.4	3.98	0.05	0.01	18	48	32.8	15.5	
Seepage 5	27.85853	-82.77931	5/12/2020	10:59	11:05	5400	7.35	599	6.62	79.7	0.29	24.6	0.02	0.14	2.03	0.02	0.01	22	27	29.1	9.98	
Seepage 1			3/31/2021	-	10:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Hose broken on meter
Seepage 2	27.8606	-82.77861	3/31/2021	-	10:25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bags reset
Seepage 3	27.85937	-82.77893	3/31/2021	-	10:50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bags reset
Seepage 4	27.85898	-82.77945	3/31/2021	-	11:25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bags reset
Seepage 5	27.85853	-82.77931	3/31/2021	-	11:40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bags reset
Seepage 1			6/8/2021	-	10:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Hose broken on meter
Seepage 2	27.8606	-82.77861	6/8/2021	9:50	9:55	9900	7.35	442.4	4.18	55.6	0.34	30.38	0.01	0.19	2.25	0.08	0.01	27	24	42.4	8.76	
Seepage 3	27.85937	-82.77893	6/8/2021	-	10:20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Site too shallow and mucky to get too
Seepage 4	27.85898	-82.77945	6/8/2021	-	10:35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bag ripped by Alligator
Seepage 5	27.85853	-82.77931	6/8/2021	-	11:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Pipe broken
Seepage 1			7/29/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Broken hose
Seepage 2	27.8606	-82.77861	7/29/2021	9:34	9:37	3500	7.58	200.8	3.23	41.9	0.09	28.8	0.1	0.38	4.01	1.23	0.01	12	16	14.6	2.9	Little water in the bag
Seepage 3	27.85937	-82.77893	7/29/2021	9:22	9:24	18400	8.06	659	5.21	67.4	0.32	28.7	0.08	0.3	2.83	0.56	0.01	35	87	44	9.75	
Seepage 4	27.85898	-82.77945	7/29/2021	8:49	8:53	11300	7.97	542	3.65	47.8	0.26	29.4	0.01	0.16	2.49	0.01	0.01	28		36.9	8.19	
Seepage 5	27.85853	-82.77931	7/29/2021	9:10	9:16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fixed pipe and made first hose connection

References

Janicki Environmental, Inc. (2003). "A Design of a Surface Water Quality Monitoring Program for Pinellas County, Florida." Report prepared for Pinellas County Department of Environmental Management, May 8, 2003.

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