Bellows Lake Outlet

STREAM HABITAT ASSESSMENT, STREAM CONDITIONS INDEX, LINEAR VEGETATION SURVEY, RAPID PERIPHYTON SURVEY AND WATER QUALITY

David Eilers, Lauren Kier, Megan Dunne | USF Water Institute | April 7, 2021

Methods

STUDY AREA ANALYISIS

The watershed containing the stream being assessed was analyzed using ESRI ArcGIS 10.2. Using this software with 2020 Hillsborough County aerial, 2017 Land Use/ Land Cover (LULC) and Waterbody ID (WBID) layers courtesy of the Florida Department of Environmental Protection (FDEP). The Landscape Development Intensity Index (LDI) was calculated for the WBID containing the stream. From FDEP (https://floridadep.gov/dear/bioassessment/content/bioassessment-ldi-hdg-bcg) "The Landscape Development Intensity index (LDI) is an estimate of how much humans have altered an area of interest around a waterbody. Various land use types (low density residential, row crops, industrial and natural) are assigned coefficients of land use intensity based on estimates of the amount of human energy that is put into those land use types."

The LDI is calculated by multiplying each land use coefficient by the percentage of the area of interest occupied by that land use, and then summing the results. The FDEP uses the LDI as a tool to estimate potential land use impacts on streams, lakes, and wetlands. LDI values less than two (≤ 2) can be considered minimally disturbed." In the Florida framework, the maximum LDI index score is approximately 42.

HABITAT AND VEGETATION ASSESSMENT

For small streams that are not easily navigated by Jonboat for bathymetric mapping and vegetation analysis, Hillsborough County requested the implementation of the FDEP methods for Stream and River Habitat Assessment (FT 3100) (http://www.dep.state.fl.us/water/sas/sop/sops.htm) using forms FD 9000-3, FD 9000-4 and FD 9000-5, Rapid Periphyton Survey (FS 7230) using form FD 9000-25 and Linear Stream Vegetation Survey (FS 7320) using form FD 9000-32. These methods were utilized on two sampling locations on each stream, typically near access points along roadways.

Stream and River Habitat Assessment per FT3100 receives a score calculated in Form FD 9000-5. This score results from the ranking of the primary habitat components (substrate diversity, substrate availability, water velocity and habitat smothering) and secondary habitat components (Artificial channelization, bank stability, riparian buffer zone width and riparian zone vegetation quality). The maximum score possible in this method is a 160.

Two metrics are utilized in the Linear Vegetation Survey (LVS). The Mean Coefficient of Conservatism (CoC) applies a score of 0-10 to each species based on its ecological tolerances and fidelity to pre-settlement conditions. Species with higher scores show a high fidelity to native, undisturbed habitats and are typically sensitive to alterations. Available CoC scores can be obtained from Table LVI 1000-1 from the Florida Department of Environmental Protection at: http://www.dep.state.fl.us/water/sas/sop/sops.htm. The Percent Florida Exotic Pest Plant Council (% FLEPPC) metric calculates the percent invasive exotics as the number of occurrences of FLEPPC Category I or II in the 100 m reach divided by the total number of taxa occurrences in the 100 m reach. The FLEPPC list can be found in FDEP LVI 1000-1.

STREAM CONDITION INDEX ASSESSMENT

The Stream Condition Index (SCI) was sampled and calculated per DEP SOP SCI 1000. . The SCI consists of collecting macroinvertebrates via 20 D-frame dipnet sweeps (0.5 m in length) in the most productive habitats in a 100 m reach of stream. The organisms are sub-sampled, and identified to the lowest practical taxonomic level. The SCI is composed of ten metrics, eight of which decrease in response to human disturbance, with two metrics (% very tolerant and % dominant) increasing in response to human disturbance. According to DEP SOP SCI 1000, the SCI scores greater than 35 are considered healthy. Proposed biological health assessment criteria state that a WBID is considered to meet designated uses if the average of the two most recent SCI scores is 40 or higher and neither of the most recent of those scores is less than 35.

WATER QUALITY ASSESSMENT

Physical water quality samples were taken using a Eureka Manta Sub-2 multiprobe pre and post calibrated daily. Measurements taken with this device include: depth, conductivity, pH, Dissolved Oxygen (mg/l and % Saturation) and salinity. Chemical water parameters were collected and preserved on ice by USF Water Institute staff and analyzed at the Hillsborough County Public Utilities Laboratory. Analysis include; Chlorophyll (a, b, c, t and corrected), Alkalinity, Color, E. Coli, Enterococci, Ammonia, Nitrates/Nitrites, Total Phosphorous, Kjeldahl Nitrogen and Total Nitrogen. Results will be discussed in the Florida Department of Environmental Protection's Numeric Nutrient Criteria framework and combined with the monthly sampling from the Hillsborough County Environmental Protection Commission Monthly sampling data.

Study Area

Bellows Lake Outlet is located in central Hillsborough County in the Hillsborough Bay Watershed. Its headwaters are located in Bellows Lake (East Lake). The outfall of Bellows Lake Outlet is in the Six Mile Creek. The assessment of Bellows Lake Outlet was conducted on April 7, 2021. At the time of the assessment, the water levels were normal for the dry season. The Bellows Lake Outlet WBID covers 1.28 square miles and is dominated by residential (32.8%), commercial (18.3%) and industrial (11.2%) land uses. The resulting calculated landscape development intensity index score was 6.95.

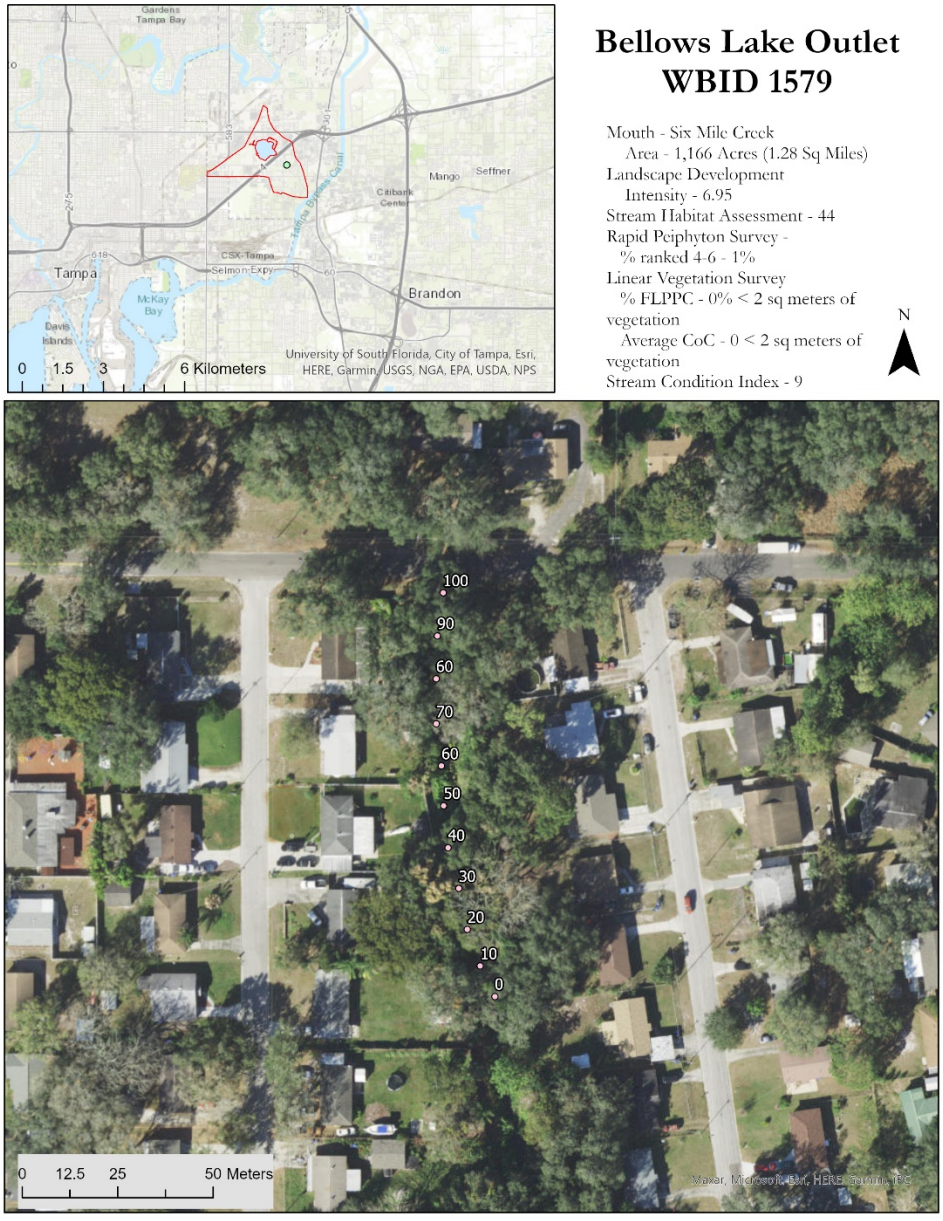

Figure 1 2021 Bellows Lake Outlet Study Area Map

Figure 2 Overview photograph of the Bellows Lake Outlet Sample Site showing the typical habitat features

Habitat and Vegetation Assessment

The region of Bellows Lake Outlet where the assessment was conducted is in a residential region downstream from the Chelsea Avenue. The region was heavily shaded with a mean canopy cover measurement of 89.5%. Bellows Lake Outlet averaged 0.1 meters in depth, approximately 1.5 meters wide with a flow of 0.06 m/s.

The primary habitat components of the FDEP Habitat Assessment focus on in-water habitat. The primary habitat components score in the marginal category for Substrate Diversity (Presence of two major productive habitats (snags, roots)) and Water Velocity (0.06 m/s). Habitat Smothering (insufficient pools and many of the productive habitats were affected by sand smothering) and Substrate Availability (4.3% of stream are productive habitats) were scored as poor. Minor habitats included leaf packs/mats and sand and silt deposits. The total score for the primary habitat components was a 21 out of 80.

The secondary habitat components of the FDEP Habitat Assessment focus on the surrounding features of the stream. The secondary habitat components scored in the marginal category for Bank Stability (both banks with raw eroded areas and high banks). Artificial Channelization, Riparian Zone Vegetation Quality (both banks showing high levels of disturbance shown in the species present) and Riparian Buffer Zone Width (less than 5 meters of buffer) scored in the poor category. The secondary habitat components received a score of 23 out of 80. The resulting FDEP Habitat Assessment score was a 44.

Table 1 Scoring Summary for the Stream Habitat Assessment

Metric	Score
Primary Habitat Components	
Substrate Diversity	6
Substrate Availability	4
Water Velocity	7
Habitat Smothering	4
Primary Score	**21**
Secondary Habitat Components	
Artificial Channelization	4
Bank Stability - Right Bank	5
Bank Stability - Left Bank	4
Riparian Buffer Zone Width - Right Bank	2
Riparian Buffer Zone Width - Left Bank	2
Riparian Zone Vegetation Quality - Right Bank	2
Riparian Zone Vegetation Quality - Left Bank	2
Secondary Score	**23**
Habitat Assessment Score	**44**

Periphyton was encountered in 1% of samples during the 99 samples taken during the Rapid Periphyton Survey. The tree canopy in the assessment area averaged 89.5% reducing available light for periphyton to flourish.

The FDEP Linear Vegetation Survey encountered less than 2 m^2 of herbaceous species rooted in Bellows Lake Outlet at the time of the assessment. The vegetation surrounding the creek was dominated by invasive species.

Table 1 Linear Vegetation Survey Results – Bellows Lake Outlet

Taxa Name	C of C Score	Sample Site										Total Occurrences
		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	
Less than 2m^2												

Figure 3 Rocks were the most abundant major productive habitat in Bellows Lake Outlet.

Stream Condition Index

The analysis of the SCI sample involves splitting the sample into 2 aliquots for analysis. The SCI metrics are then calculated on each separately. The final SCI score is an average of the two scores. The SCI score for Bellows Lake Outlet was 9 out of a possible 100 points, corresponding with an "Impaired" designation, with noticeable loss of taxonomic diversity from the expected community of a healthy stream. Both subsamples contained few total taxa with only 13 taxa in subsample A and 10 in subsample B. The most recent previous SCI assessment at this location was conducted on 1/9/2019 with a SCI score of 18.

High scores (scores above 7.0) were not achieved for any of the 10 SCI metrics in either sample. Low scores (less than 3.0) were achieved for the Total Taxa, Total Ephemeroptera, Total Trichoptera, % Filter Feeders, Total Clingers, Total Long Lived Taxa, % Tanytarsini and Total Sensitive Taxa in both subsamples. The % Very Tolerant Individuals metric in Sample A also scored low. Neither subsample contained Ephemeroptera, Trichoptera, Clinger, Tanytarsini, Long-Lived or Sensitive Taxa. The full results of the SCI sampling are shown in Table 3 (Sample A) and Table 4 (Sample B) for Bellows Lake Outlet.

Table 2 SCI metric summaries for Bellows Lake Outlet Sample A (top) and Sample B (bottom)

SCI Metric	Raw Totals	SCI scores	Adjusted SCI scores
Total Taxa	13.00	-0.83	0.00
Total Ephemeroptera	0.00	0.00	0.00
Total Trichoptera	0.00	0.00	0.00
% Filter Feeders	2.22	0.35	0.35
Total Clingers	0.00	0.00	0.00
Total Long-lived Taxa	0.00	0.00	0.00
% Dominance	36.08	5.58	5.58
% Tanytarsini	0.00	0.00	0.00
Total Sensitive Taxa	0.00	0.00	0.00
% Very Tolerant Individuals	38.61	2.55	2.55

SCI Sum	8.49
Final SCI score	9.43

SCI Metric	Raw Totals	SCI scores	Adjusted SCI scores
Total Taxa	10.00	-2.08	0.00
Total Ephemeroptera	0.00	0.00	0.00
Total Trichoptera	0.00	0.00	0.00
% Filter Feeders	2.60	0.44	0.44
Total Clingers	0.00	0.00	0.00
Total Long-lived Taxa	0.00	0.00	0.00
% Dominance	43.51	4.10	4.10
% Tanytarsini	0.00	0.00	0.00
Total Sensitive Taxa	0.00	0.00	0.00
% Very Tolerant Individuals	29.87	3.18	3.18

SCI Sum	7.72
Final SCI score	8.57

Table 3 SCI full results for Sample A

Stream Condition Index Results for Bellows Outlet SCIA

Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Abundance	Collapsed Abundance	Taxa Presence	Ephemeroptera Taxa	Trichoptera Taxa	50% Filterer	100% Filterer	Clinger Taxa	Long-lived Taxa	Dominant Taxa	Tanytarsini	Sensitive Taxa	Very Tolerant Individuals	Specimen Notes
Platyhelminthes						Platyhelminthes spp.	1	1	1	0	0	0	0	0	0		0	0	0	
Annelida		Clitellata	Hirudinida	Rhynchobdellida	Glossiphoniidae	*Helobdella elongata*	1	1	1	0	0	0	0	0	0		0	0	1	
Annelida		Clitellata	Hirudinida	Rhynchobdellida	Glossiphoniidae	*Helobdella stagnalis* sp. complex	19	19	1	0	0	0	0	0	0		0	0	19	
Mollusca		Bivalvia	Autobranchia	Sphaeriida	Sphaeriidae	*Musculium* spp.	2	2	1	0	0	0	2	0	0		0	0	0	
Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyalellidae	*Hyalella azteca* sp. complex	32	32	1	0	0	0	0	0	0		0	0	0	Max1 dissected; damaged/not H. wakulla
Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyalellidae	*Hyalella wakulla*	57	57	1	0	0	0	0	0	0		0	0	0	Max1 dissected
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Chironomus* spp.	4	4	1	0	0	0	0	0	0		0	0	4	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Glyptotendipes* spp.	5	5	1	0	0	0	0	0	0		0	0	5	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Dicrotendipes* spp.	3	3	1	0	0	1.5	0	0	0		0	0	0	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Goeldichironomus* spp.	2	2	1	0	0	0	0	0	0		0	0	2	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Polypedilum beckae*	30	30	1	0	0	0	0	0	0		0	0	30	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Ceratopogonidae	Ceratopogonidae spp.	1	1	1	0	0	0	0	0	0		0	0	0	1 larva, not Forcipomyia
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Ceratopogonidae	*Forcipomyia* spp.	1	1	1	0	0	0	0	0	0		0	0	0	Larva = 1

Table 4 SCI full results for Sample B

Stream Condition Index Results for Bellows Outlet SCIB

Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Abundance	Collapsed Abundance	Taxa Presence	Ephemeroptera Taxa	Trichoptera Taxa	50% Filterer	100% Filterer	Clinger Taxa	Long-lived Taxa	Dominant Taxa	Tanytarsini	Sensitive Taxa	Very Tolerant Individuals	Specimen Notes
Annelida		Clitellata	Hirudinida	Rhynchobdellida	Glossiphoniidae	*Helobdella elongata*	1	1	1	0	0	0	0	0	0		0	0	1	
Annelida		Clitellata	Hirudinida	Rhynchobdellida	Glossiphoniidae	*Helobdella stagnalis* sp. complex	7	7	1	0	0	0	0	0	0		0	0	7	
Mollusca		Gastropoda	Heterobranchia	Hygrophila	Ancylidae	Ancylidae spp.	1	1	1	0	0	0	0	0	0		0	0	0	Damaged; no shell
Mollusca		Bivalvia	Autobranchia	Sphaeriida	Sphaeriidae	*Musculium* spp.	3	3	1	0	0	0	3	0	0		0	0	0	
Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyalellidae	*Hyalella azteca* sp. complex	32	32	1	0	0	0	0	0	0		0	0	0	Max1 dissected; damaged/not H. wakulla
Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyalellidae	*Hyalella wakulla*	67	67	1	0	0	0	0	0	0		0	0	0	Max1 dissected
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	Chironomidae spp.	1		0	0	0	0	0	0	0		0	0	0	Pupa = 1
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Glyptotendipes* spp.	6	6	1	0	0	0	0	0	0		0	0	6	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Dicrotendipes* spp.	2	2	1	0	0	1	0	0	0		0	0	0	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Goeldichironomus* spp.	4	4	1	0	0	0	0	0	0		0	0	1	
Arthropoda	Hexapoda	Insecta	Pterygota	Diptera	Chironomidae	*Polypedilum beckae*	30	31	1	0	0	0	0	0	0		0	0	31	

Water Quality Assessment

Long-term water quality data is available for Bellows Lake Outlet. The data that is available was collected by the FDEP and Hillsborough County Environmental Protection Commission. Values for the physical water parameters begin in 2005 and continue through 2021. Values for the laboratory water parameters begin in 2005 through 2021. The 2021 USF Water Institute Assessment fall within the range of the previous data collections. Table 5 provides a summary of the Physical/Chemical conditions recorded at the site.

Table 5 Bellows lake Outlet Physical Water Quality (Field)

Bellows Lake Outlet								
Date	**Depth (m)**	**Temp (°C)**	**pH**	**DO (mg/L)**	**DO (% Sat)**	**Cond (UMHO/cm)**	**Salinity (PPT)**	**Secchi Depth (m)**
4/7/2021	0.14	20.22	7.33	3.39	37.1	246.2	0.11	0.2 VOB
Mean POR	0.2	22.55	7.15	2.56	29.80	211.0	0.09	0.69

The chemical water quality analysis for Bellows Lake Outlet is shown in Table 6 along with mean values for the period of record for available parameters. The previous 3-year geometric mean values for Total Phosphorous values were below the nutrient region threshold developed by FDEP of 0.49 mg/L with a geometric mean value of 0.102 mg/L (0.107 mg/L (2019), 0.093 mg/L (2020) and 0.098 mg/L (2021)). Total Phosphorous values for the sample from this assessment were 0.180 mg/L. Total Nitrogen values were above the nutrient region threshold developed by FDEP of 1.65 mg/L for the previous three year period with a mean value of 2.224 mg/L (2.029 mg/L (2019), 2.614 mg/L (2020) and 2.410 mg/L (2021)). The Total Nitrogen value from the assessment was above the threshold with a concentration of 2.380 mg/L. Chlorophyll-a corrected values fall above the site specific evaluation range of 3.2 µg/l to 20 µg/l for the most recent 3-years of samples 28.49 µg/l (66.58 µg/l in 2019, 14.76 µg/l in 2020, 1.54 µg/l in 2021). For sites with Chlorophyll-a values above this range, the assessment is indicating conditions reflecting an imbalance in flora.

An elevated biomass of the bacterial parameters was observed in the 3-year dataset with E. Coli having a geomean of 1,260.7 colonies/100 ml, 986.1/100 ml for Enterococci.

Table 6 Bellows Lake Outlet Water Quality (Laboratory)

Parameter	Bellows Lake Outlet 4/7/2021	POR Mean (2005-2021)	Units
E. Coli	1,640	1,465	#/100 ml
Enterococci	3,270	1,158	#/100 ml
Chlorophyll a	50.8	71.06	ug/L
Chlorophyll b	1.6	1.70	ug/L
Chlorophyll c	1.6	3.06	ug/L
Chlorophyll t	50.8	33.7	ug/L
Chlorophylla Corr	1.6	35.5	ug/L
Chlorophyll-pheo	82.6	56.7	ug/L
Ammonia	0.615	0.238	mg/L
Kjeldahl Nitrogen	2.320	2.138	mg/L
Total Nitrogen	2.380	2.123	mg/L
Nitrates/Nitrites	0.064	0.024	mg/L
Total Phosphorus	0.180	0.107	mg/L

Conclusion

Bellows Lake Outlet at Chelsea Avenue is located in a predominantly residential area. At the time of the habitat assessment, the water levels were low, corresponding to the middle of the dry season, however sufficient habitat for macroinvertebrates was observed. Due to these factors, the Habit Assessment resulted in a poor score of 44. Disruption to the vegetation community was not observed in the results of the Linear Vegetation Survey with Bellows Lake Outlet having below 2 square meters of rooted herbaceous vegetation. Bellows Lake Outlet did meet standards for the rapid periphyton survey with 1% of samples being ranked between 4 and 6 due to the heavy canopy coverage in the region. The recent water quality record for Bellows Lake Outlet showed concentrations of Chlorophyll-a corrected and Total Phosphorous below the FDEP thresholds but the and Total Nitrogen values exceeded the FDEP thresholds. The results of the SCI sampling indicate that the stream is "impaired" based on the macroinvertebrate community. Table 7 summarizes the results of the nutrient sampling, floristic sampling, habitat assessment and SCI.

Table 7 Summary of Water Quality, Floristic Surveys and Habitat Assessments

Measure		Bellows Lake Outlet	2019	2020	2021	Threshold
Total Phosphorous (mg/l)		0.180	0.107	0.093	0.098	< 0.49
Total Nitrogen (mg/l)		2.380	2.029	2.614	2.410	< 1.65
RPS (% Rank 4-6)		1%	3%			< 25%
LVS	**Avg C of C**	N/A	0.91			≥ 2.5
	FLEPPC %	N/A	90.9%			< 25%
Chlorophyll-a Corrected (µg/l)		1.6	66.58	14.76	1.54	< 20 µg/l
Habitat Assessment		44	54			> 34
SCI		9	18			> 34