# LOXAHATCHEE RIVER WATER QUALITY MONITORING

## TASK 2: FINAL REPORT

## ASSESSMENT OF 2014-2015 LOXAHATCHEE RIVER WATER QUALITY

In Partial Fulfillment of Agreement No. S0788

For the Period

July 2014 through September 2015

Respectfully Submitted by

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Loxahatchee River District

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## Introduction

South Florida contains some of the most productive ecosystems in the world, including coral reefs, seagrass beds, mangrove forests and cypress swamps (Harwell 1998, Fourqurean et al. 2001, Ross et al. 2001, Kendrick et al. 2012). However, it is estimated that over 6.7 million people populate the region, with a net rate of increase of 1 million people per decade, directly and indirectly influencing these ecosystems through several anthropogenic activities. Stressors include hydrologic regime shifts, habitat degradation, anthropogenic nutrient loading, species exploitation, chemical pollution, and sea level rise (Harwell 1998). Poor water quality is of particular concern in oligotrophic environments, which include examples across south Florida's freshwater, estuarine, and marine systems.

In response to a growing need to preserve and protect natural resources in the Loxahatchee River, a biodiverse and dynamic waterbody that provides habitat for freshwater, estuarine and marine species, the Loxahatchee River Environmental Control District (LRD) was created by the Florida Legislature in 1971 (Chapter 2002-358, Special Acts of Florida). The LRD works to fulfill its mission through the implementation of an innovative wastewater treatment and reuse program, conducting ecological research and applied restoration in the watershed, and by offering community and children-focused environmental education programs. Perhaps one of the most important aspects of the work conducted by the LRD to protect the Loxahatchee River is through extensive water quality monitoring throughout the watershed.

Today, LRD's WildPine Ecological Laboratory Staff collect water quality samples for over 20 parameters at approximately 48 sites located in the Loxahatchee River, its major tributaries, and associated waters. Thirty-eight of the sites are sampled bi-monthly (every other month), while 10 stations are sampled monthly. This water quality monitoring program, entitled RiverKeeper, was implemented to quantify spatial and temporal water quality trends. Data from this monitoring effort have been instrumental in developing water quality targets (sensu Table 10-1 in South Florida Water Management District 2006), defining numeric nutrient criteria, establishing baseline conditions for the relevant Comprehensive Everglades Restoration Plan (CERP 2001), and identifying river segments in need of water quality improvement efforts, which are often accomplished as part of Loxahatchee River Preservation Initiative projects (see http://www.lrpi.us). The purpose of this report is to summarize water quality trends in the Loxahatchee River for the period July, 2014 through September, 2015. In order to provide

historical context, we also provide a comprehensive overview of water quality conditions in the Loxahatchee River over the last decade (January 2006-September 2015).

**Site Description**

Water samples were collected at stations throughout the Loxahatchee River estuary (26º57´ N, 80º06´ W), a sub-tropical system located in southeast Florida that drains a 435 $km^2$ watershed and connects to the Atlantic Ocean through the Jupiter Inlet (Figure 1; South Florida Water Management District 2006). West of the Jupiter Inlet, the river widens into a large, centralized embayment which opens into three main tributaries: the Northwest Fork, Nork Fork, and Southwest Fork (South Florida Water Management District 2006). The Northwest Fork is classified as having variable freshwater flows that differ substantially between the summer "wet" season and the winter "dry" season, while the North Fork and Southwest Fork are classified as having brackish water with varying salinity ranges. In total, the river has nine different segments that vary in abiotic (e.g., salinity) and biotic (e.g., seagrass presence) variables, and are hereafter referred to as "limit groups" based on Florida Department of Environmental Protection (DEP) designations (Figure 1). These include: marine portions of the river, polyhaline portions of the river, meso/oligohaline portions of the river, the Wild and Scenic portion of the river, freshwater tributaries, freshwater canals, the Southwest Fork, the Intracoastal waterway-north, and the Intracoastal waterway-south.

The Loxahatchee River has undergone extensive changes over the last century, specifically, the hydrology of the Loxahatchee River has been altered to accommodate development and agriculture to the area (McPherson et al. 1982, VanArman et al. 2005). Historically (pre-1950's), most of the watershed was drained by the Northwest Fork, with the headwaters of the river originating in Loxahatchee and Hungryland Sloughs. However, the creation of the C-18 canal and S-46 flood control structure diverted excess freshwater runoff from the Northwest Fork to the Southwest Fork of the river. The S-46 structure is typically closed with no flow; water managers open the structure to discharge water on average 40 days per year. Additionally, the Lainhart Dam in the Northwest Fork was constructed to help reduce over drainage of upstream reaches of the Northwest Fork during the dry season, and the Jupiter Inlet has been kept permanently open to the ocean through occasional dredging practices (South Florida Water Management District, 2006). To this end, the RiverKeeper project is necessary to

elucidate effects of hydrological changes on water quality, so that resource managers may adequately mitigate these potential impacts.

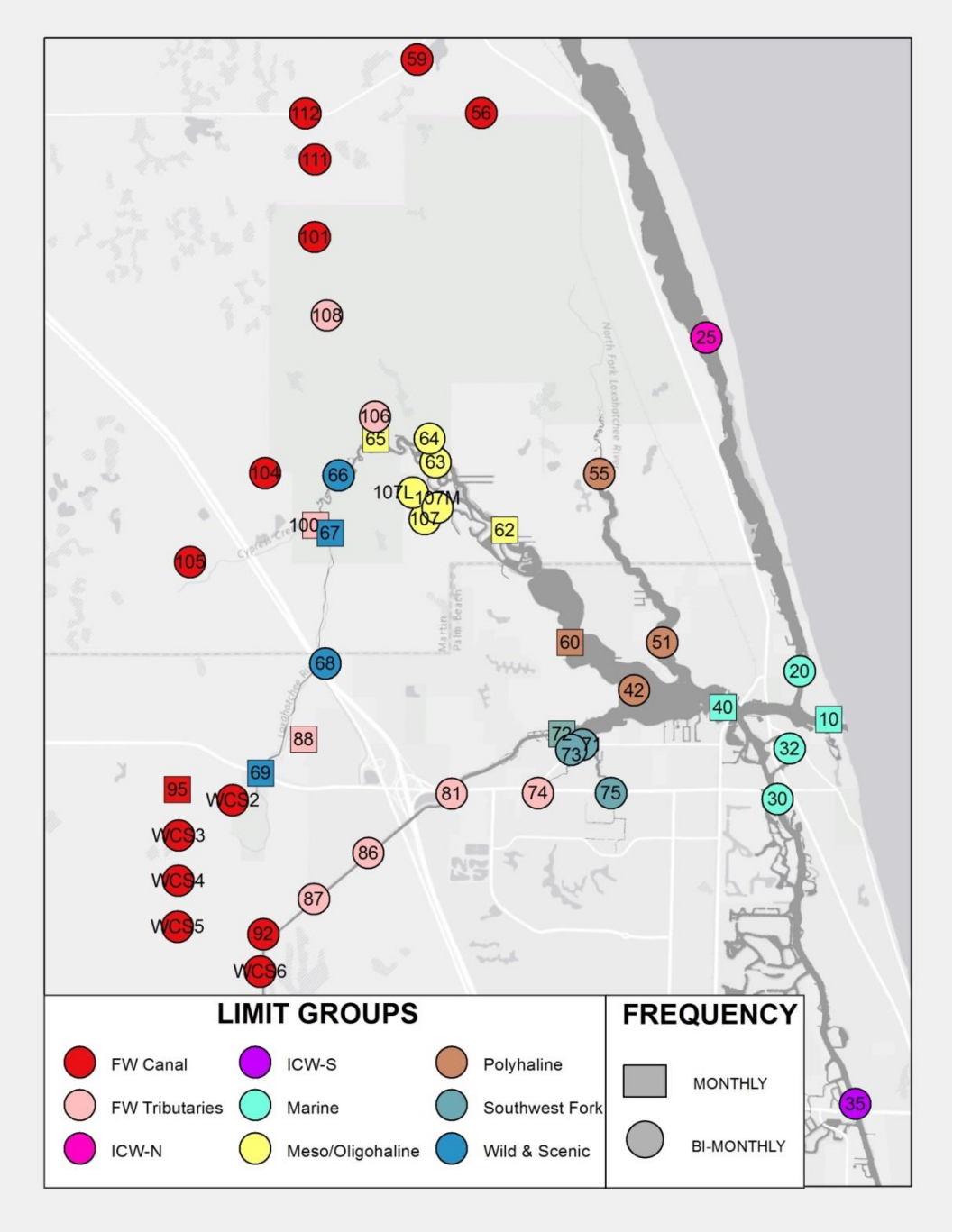


Figure 1. The WildPine Laboratory RiverKeeper water quality stations, located throughout the Loxahatchee River and watershed. Different color symbols represent the Florida DEP limit group designations, and the symbol type (square or circle) represents sampling frequency.

## Materials and Methods

*Sample Collection & Processing*- RiverKeeper water quality sampling stations (N = 48) are located throughout the watershed (Table 1) and were sampled monthly or bi-monthly (every other month) by vehicle or boat. At each station, physical water quality conditions (e.g., temperature, pH, conductivity, salinity, and dissolved oxygen) were evaluated using a Hydrolab multiprobe at the surface (0.3 m depth), and where appropriate, at mid-depth and within 20 cm of the bottom. A secchi disk was also used to assess water clarity at each station, and total water depth was recorded. Photosynthetically active radiation (PAR) was assessed by taking 3 replicates of PAR using 3 LI-COR spherical sensors (4 π) simultaneously located at 20 cm, 50 cm, and 100 cm below the water surface.

At each location, water samples were collected from the surface of the water using acid-washed HDPE plastic sampling bottles. Samples collected for nitrate-nitrite, ortho-phosphate, and true color were field filtered using 0.45 µm membrane filters prior to analysis to remove particulate matter; water was filtered into 250ml HDPE bottles and immediately placed on ice. Samples were refrigerated at 4°C and analyzed within 48 hours using a Lachat Flow Injection Analyzer following standard methodologies (Table 2). Water samples collected to analyze ammonia, total kjeldahl nitrogen, and total phosphorus were field-preserved to pH < 2.0 with sulfuric acid and transported on ice. Samples were refrigerated at 4°C and analyzed within 28 days. For ammonia samples, all suspended solids and other potential sources of interference were removed through a distillation process; for total kjeldahl nitrogen samples, organic sources of nitrogen were converted to ammonium sulfate through a digestion process. Once samples were prepared, ~10ml of sample for each analyte was transferred to a glass cuvette and analyzed via Lachat Flow Injection Analyzer using standard methods (Table 2). Enterococci and fecal coliform bacteria samples were collected using sterile Idexx© bottles, placed on ice, and analyzed using standard methods (Table 2). Chlorophyll *a* samples were collected in amber 2L HDPE bottles, placed on ice, and filtered in dark conditions using 0.47mm diameter glass microfiber filters, then analyzed using standard methods (Table 2). Additionally, raw surface water samples (e.g., samples not filtered or acidified) were processed for alkalinity, turbidity, and total suspended solids using standard methodologies (Table 2). All sample collection and field testing activities were performed in accordance with DEP Standard Operating Procedures for Field Activities (DEP-SOP-001/01, March 1, 2014). All sampling protocol and lab analysis during the

reporting period were in accordance with National Environmental Laboratory Accreditation (NELAC) requirements.

In addition to sampling RiverKeeper stations, we also conducted an independent project in certain sub-watersheds to sample sucralose, an artificial sweetener that is a proven indicator of human wastewater, including septic tank effluent, treated wastewater, and reclaimed water (Oppenheimer et al. 2011). Sucralose samples were primarily collected to understand the potential impact of septic system effluent in areas with poor water quality (Table 3, Figure 6). Sites sampled for sucralose were selected due to their known proximity to homes on septic tanks or locations where high fecal coliform bacteria concentrations, indicating potential human waste streams, were reported. Water samples were immediately placed on ice and sent to Eurofins Scientific Laboratory in Monrovia, CA for analysis. Eurofins evaluates sucralose through the use of online solid-phase extraction coupled with high-performance liquid chromatography mass spectrometry in tandem (LC-MS/MS) analysis (Table 3).

*Data preparation and analysis*- All data were organized by limit group and year (January 2006-September 2015) in Microsoft Excel. Box and whisker plots, bar, or line graphs were then created evaluating long-term trends in key water quality parameters: total nitrogen, total phosphorus, corrected chlorophyll *a*, and fecal-coliform concentrations using SPSS (IBM version 23.0). We included the DEP-Environmental Protection Agency (EPA) numeric nutrient criteria (NNC) for each limit group on these figures to provide context as to whether our water quality data met or exceeded water quality thresholds (symbolized with a red-dotted line and corresponding NNC threshold value). Short-term trends in water quality for all physico-chemical parameters were also evaluated from July 2014 to September 2015 across all limit groups using box and whisker plots in SPSS (IBM version 23.0). In addition to the box and whisker plots, we used a 'stoplight' approach to provide a simplified, integrated assessment of observed water quality conditions (total nitrogen, total phosphorus, chlorophyll *a*, and fecal coliform concentrations) relative to target water quality values for each of the nine limit groups from 1991 to 2015. Analytical results for each river reach were divided into three categories (red, yellow, and green), which can be interpreted similar to the colors in a traffic signal. Green indicates good or acceptable conditions – no degradation is occurring. Yellow indicates caution should be observed – degradation may or may not be occurring (i.e., there may be cause for concern). Red indicates degradation likely is occurring, and resource managers should stop and determine what

actions might be employed to remedy the degradation in observed conditions.

To determine if enterococci bacteria concentrations fell within acceptable limits for each Loxahatchee River waterbody segment (i.e., WBID) as defined by the DEP, we calculated the Ten Percent Threshold Value (TPTV). The TPTV was calculated by taking the number of samples per year for each WBID that were greater than 130 cfu, and dividing that number by the total sample size for that WBID/year. If the TPTV exceeded 10%, we failed to meet enterococci bacteria criteria for that particular region/year. Similarly, for sucralose concentrations, we calculated the proportion of sucralose concentrations that were above the detection limit (> 50 ng/L) over the total number of samples collected from each sampling location. We did this to account for the fact that we sampled some locations only once, while others were sampled several times (Table 3). Arc GIS (Esri 2013) was then used to create figure maps for TPTV calculations for enterococci in the different WBIDS from 2011-2015. GIS was also used to map sucralose values for each sampling location.

Finally, to explore potential relationships between certain water quality parameters (e.g., chlorophyll *a* concentrations and total phosphorus), we ran Pearson bivariate correlations using SPSS (IBM version 23.0). We also examined whether chlorophyll *a*, total nitrogen, and total phosphorus concentrations at site 72 in the Southwest Fork downstream of the S-46 control structure, and site 81 (used as a reference location upstream of S-46) were different, and whether chlorophyll *a* concentrations within site 72 varied based on flow. As such, we compared mean chlorophyll *a*, total phosphorus, and total nitrogen concentrations at site 72 and 81 using independent samples t-test with SPSS (IBM version 23.0).

**Results & Discussion**

From 2006-2015, LRD staff collected over 3,000 samples and obtained over 7,000 individual results for 24 different parameters (Appendices A-C). Key water quality parameters including total nitrogen (TN), total phosphorus (TP), chlorophyll *a*, and fecal coliform bacteria concentrations varied spatially for the period 2006-2015 (Figure 2). Marine, polyhaline, and Intracoastal Waterway-north and south limit groups had consistently low TN, TP, chlorophyll *a*, and fecal coliform concentrations (Figure 3). Meso-oligohaline and Southwest Fork portions of the river had consistently elevated chlorophyll *a*, fecal coliform and enterococci concentrations (Figures 3C, 3D, 3E, respectively). Freshwater limit groups (Wild & Scenic, FW Tributaries, &

FW Canals) generally had higher TN and TP concentrations than other limit groups (Figures 3A and 3B, respectively). Herein, we provide a more complete description of water quality trends over the last decade for each limit group in the Loxahatchee River (organized from downstream-upstream).

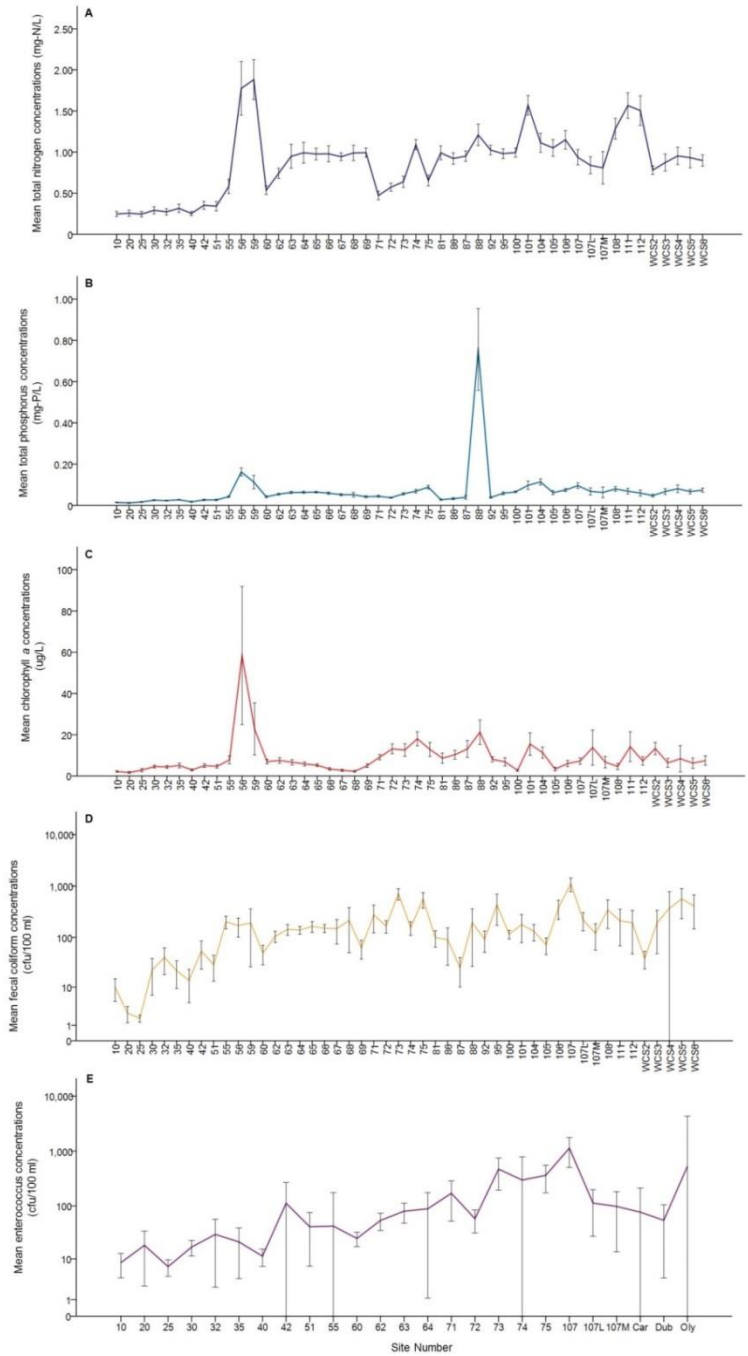


Figure 2. Water quality trends for total nitrogen (2A), total phosphorus (2B), chlorophyll *a* concentrations (2C), fecal coliform (2D), and enterococci bacteria concentrations (2E) from January 2006-September 2015 across all sites. Note that the fecal coliform and enterococci panels are to log scale.

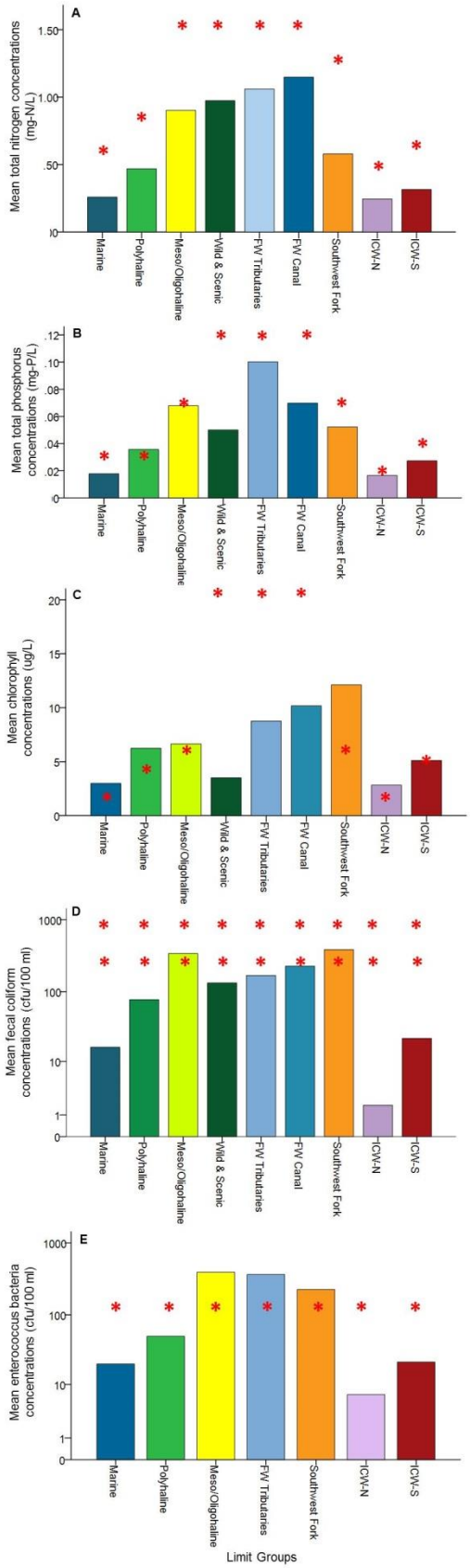


Figure 3. Water quality trends for total nitrogen (3A), total phosphorus (3B), chlorophyll *a* concentrations (3C), fecal coliform (3D), and enterococci bacteria concentrations (3E) from January 2006-September 2015 across all DEP limit groups. Red asterisks denote NNC thresholds for each limit group. Note that the fecal coliform and enterococci panels are to log scale.

The marine, polyhaline, and intracoastal waterway-south and north portions of the river each have had good water quality over the last decade (Appendix B). Chlorophyll *a* concentrations have been slightly elevated in each limit group, though we believe NNC thresholds are too stringent (1.9 and 4.7 ug/L for N. and S.) for these waterbodies. We attribute the good water quality in these water bodies (perhaps with the exception of polyhaline sites) to flushing from the ocean.

In the meso-oligohaline portions of the river, or the middle-reaches of the river, water quality for all four parameters was somewhat poor, though TN was only high (exceeding NNC) from 2006-2007 (Appendix B). Poor water quality was largely driven by site 107, which is adjacent to the River's Edge community (26°58'41.85"N 80° 8'46.03"W). Total phosphorus, chlorophyll *a* and enterococci concentrations routinely exceeded NNC thresholds, with site 107 frequently generating a red stoplight indicating poor water quality for TP, chlorophyll *a* and fecal coliform (Appendix C). The River's Edge community relies on septic systems for on-site wastewater treatment, and these data combined with sucralose results indicate septic system effluent is degrading water quality in this portion of the river.

Water quality in the Wild and Scenic portion of the Loxahatchee River has typically met NNC thresholds over the past decade (Appendix B). In general, the water quality in the Wild and Scenic portion of the river reflects the low nutrient concentrations typically observed in the C-18 canal (e.g., station 81, 86, and 87), though more work needs to be conducted to determine elevated nutrient concentrations occasionally observed at Site 69 (see asterisks indicating heightened nutrient concentrations in this site, Appendix B) are due to poor water quality being discharged from Jupiter Farms surface water canal drainage system.

Water quality in freshwater tributaries typically fell below NNC threshold values, though TP was elevated from 2008-2014 (Appendix B). Elevated TP may have been largely driven by station 88. The Loxahatchee River District has been closely monitoring Station 88, which drains fallow agriculture lands on the northern half of Parcel 19 (north of Indiantown Rd and west of the Turnpike) directly to the Loxahatchee River freshwater floodplain. The Town of Jupiter has implemented development order conditions that should result in meaningful improvements to stormwater quality being discharged off this property and to the Loxahatchee River.

Water quality at freshwater canal sites has fallen within- or below- the NNC thresholds over the last decade, with the exception of TN concentrations (Appendix B). Elevated TN

concentrations at stations 101, 111, and 112, drainage ditches in the Bridge Road area will hopefully be attenuated following the completion of the Martin County Kitching Creek Central Flow Way Project. Additional restoration work is needed to address poor water quality at Station 56, which ultimately flows to the North Fork of the Loxahatchee River. This station routinely exceeded NNC for total phosphorus and chlorophyll *a*, and may be related to nearby golf-course runoff or an adjacent roadside ditch.

The Southwest Fork downstream of the S-46 flood control structure, and Jones and Sims Creeks have consistently experienced poor water quality over the last decade (Appendix B). Total phosphorus, chlorophyll *a*, and fecal coliform concentrations have exceeded NNC thresholds, though TN has fallen well-within range of the NNC threshold each year. Of particular concern are chlorophyll *a* concentrations, which come in as red signifying water quality degradation in the 'stoplight' plot every year (Appendix C). One possible explanation for the elevated chlorophyll *a* concentrations in the Southwest Fork may stem from long mean residence times. Specifically, the Southwest Fork may experience poor flushing when the S-46 flood control structure is closed. The topography of the Southwest Fork is similar to a dead-end canal from the S-46 to approximately 2,400m downstream. Despite tidal cycling, this area appears to become stagnant when the S-46 is closed, which may result in high chlorophyll *a* concentrations, particularly during the warm summer and fall months. We conducted pair-wise comparisons between station 81, the freshwater station immediately upstream of S-46, and station 72, the brackish station immediately downstream of S-46. Chlorophyll *a* concentrations were over 41% higher at site 72 compared to site 81 (Table 4). Additionally, total phosphorus concentrations differed between station 72 and 81; phosphorus was found to be 37% higher in 72 than in 81 (Table 4). Interestingly, total nitrogen concentrations in station 72 were found to be almost 43% lower than in station 81 (Table 4), though further work is necessary to elucidate why nitrogen concentrations are not elevated in station 72.

We also evaluated the effect of mean residence time on chlorophyll *a* concentrations by comparing station 72 chlorophyll *a* concentrations when 7 day flows at the S-46 water control structure were >200 cfs or < 200 cfs. Chlorophyll *a* concentrations were found to be over 137% higher in station 72 when 7 day flows were < 200 cfs (Mean ± SD = 2.5 ± 5.1) compared to chlorophyll *a* in station 72 when 7 day flows were >200 cfs (Mean ± SD = 13.3 ± 13.1) ($df = 148$, $t = -5.7$, $P < 0.001$) (Figure 4). These findings indicate that chlorophyll *a* concentrations

may increase when there is little water flushing. Not surprisingly, we also found a positive correlation between chlorophyll *a* concentrations in station 72 and TP (N = 110, r = 0.46, $P < 0.001$), and a positive correlation between chlorophyll *a* in station 72 and TN (N = 110, r = 0.20, $P = 0.03$). There were no other correlations between chlorophyll *a* and nutrient parameters (ammonia, nitrates, or orthophosphates, $P > 0.05$). Relationships between nutrient concentrations (N and P) and chlorophyll *a* are common in nature, as elevated nutrient concentrations often drive algal blooms, potentially resulting in reduced light resources for aquatic macrophytes (e.g., seagrass) (Canfield et al. 1984, Bricker et al. 200). This relationship is the most prevalent in estuaries and enclosed water bodies where reduced water flushing allows for nutrient accumulation (Bricker et al. 2008). Furthermore, on September 28, 2015, LRD staff observed a meaningful algae bloom in the Southwest Fork, just upstream of station 72, and collected a surface water sample that was analyzed by DEP and found to contain the toxic algae *Microcystis aeruginosa.* Clearly, the elevated nutrients and chlorophyll *a* concentrations in the Southwest Fork need to be addressed and remedied as we work to safeguard the health of the Loxahatchee River.

Enterococci bacteria concentrations, evaluated across several WBIDS from 2011-2015, were found to largely fall below the 10% TPTV threshold (Figure 5). However, enterococci concentrations gradually increased from 2011-2014 (they stabilized in 2015) in WBID 3226C (i.e., Southwest Fork) and 3224 (i.e., the Northwest Fork from the Martin County line to Trapper Nelson's), indicating areas of potential concern for recreational use by humans. For instance, in WBID 3224, TPTV values increased from 25% to 48.6%, meaning that in 2014, roughly 50% of the samples collected in that WBID were greater than 130 cfu. WBID 3224 encompasses the meso/oligohaline portion of the river, which had some of the poorest water quality in the river, largely influenced by a few areas of concern (e.g., the River's Edge community). As such, it is not surprising that enterococci concentrations would also be high. TPTV scores in both WBIDS were the highest in 2014, though it is unclear as to why concentrations were elevated in that year, specifically. More research is required to elucidate mechanisms driving elevated enterococci concentrations in WBID 3226C and 3224 in the future. Because water-based recreation (e.g., water skiing, kayaking) commonly occurs in WBID 3224, the Loxahatchee River District has implemented a new, weekly bacteria monitoring project that provides high-frequency bacteria sample results for this region to the public, so they can govern their exposure to river water

accordingly (http://tinyurl.com/nr7nv7b).

The proportion of sucralose samples with detectable concentrations (> 50 ng/L) over the total sample size for each sucralose sampling location were also high in the watershed. Fifty percent of all stations sampled had concentrations that were greater than 50.1 ng/L, indicating areas with potential issues with water quality degradation including septic tank effluent (Figure 6). For instance, site 107 had high sucralose concentrations present, an area with older septic systems located immediately adjacent to the river. The immediate concern is not for sucralose contamination, but that the occurrence of sucralose indicates septic system effluent is degrading surface water quality.

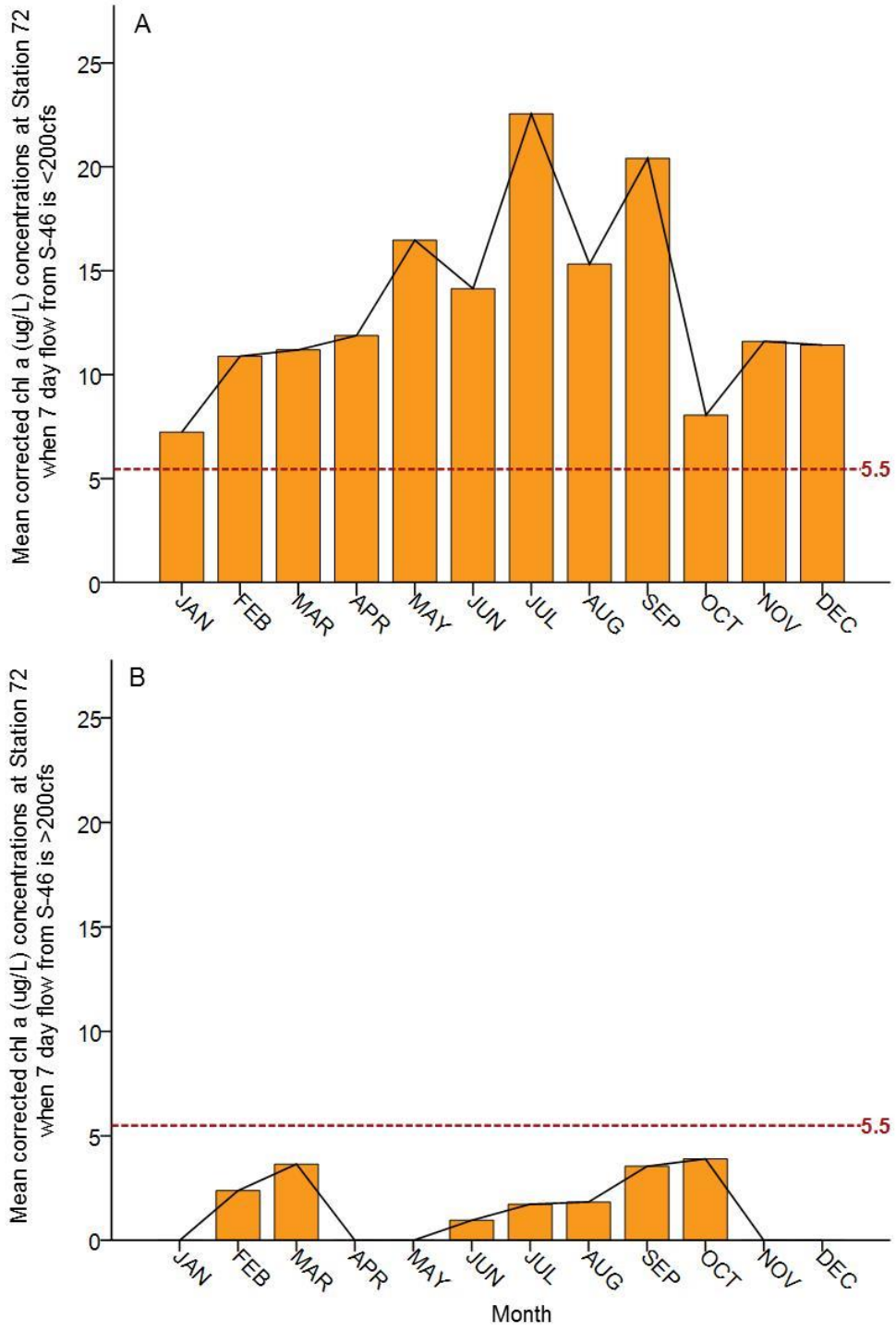


Figure 4. Mean corrected chlorophyll *a* concentrations at Station 72 in the Southwest Fork when 7 day flows from the S-46 water control structure were <200 cfs (A), and > 200 cfs (B) pooled by month from 2006-2015. The red-dotted line indicates the DEP-NNC criteria for chlorophyll *a* concentrations for the Southwest Fork of the Loxahatchee River.


Figure 5. Loxahatchee River WBID map depicting TPTV calculations for enterococci bacteria from 2011-2015. TPTV values were calculated by taking the number of enterococci samples that had concentrations > 130 cfu/100ml, and dividing that number by the total sample size for each WBID, per year. Enterococci concentrations for each WBID fail to meet DEP criteria if they exceed 10%. WBIDS highlighted in green represent TPTV values within the 10% threshold, thus meeting DEP TPTV criteria. Yellow or orange-highlighted WBIDs have failed to meet DEP TPTV criteria (>10%).

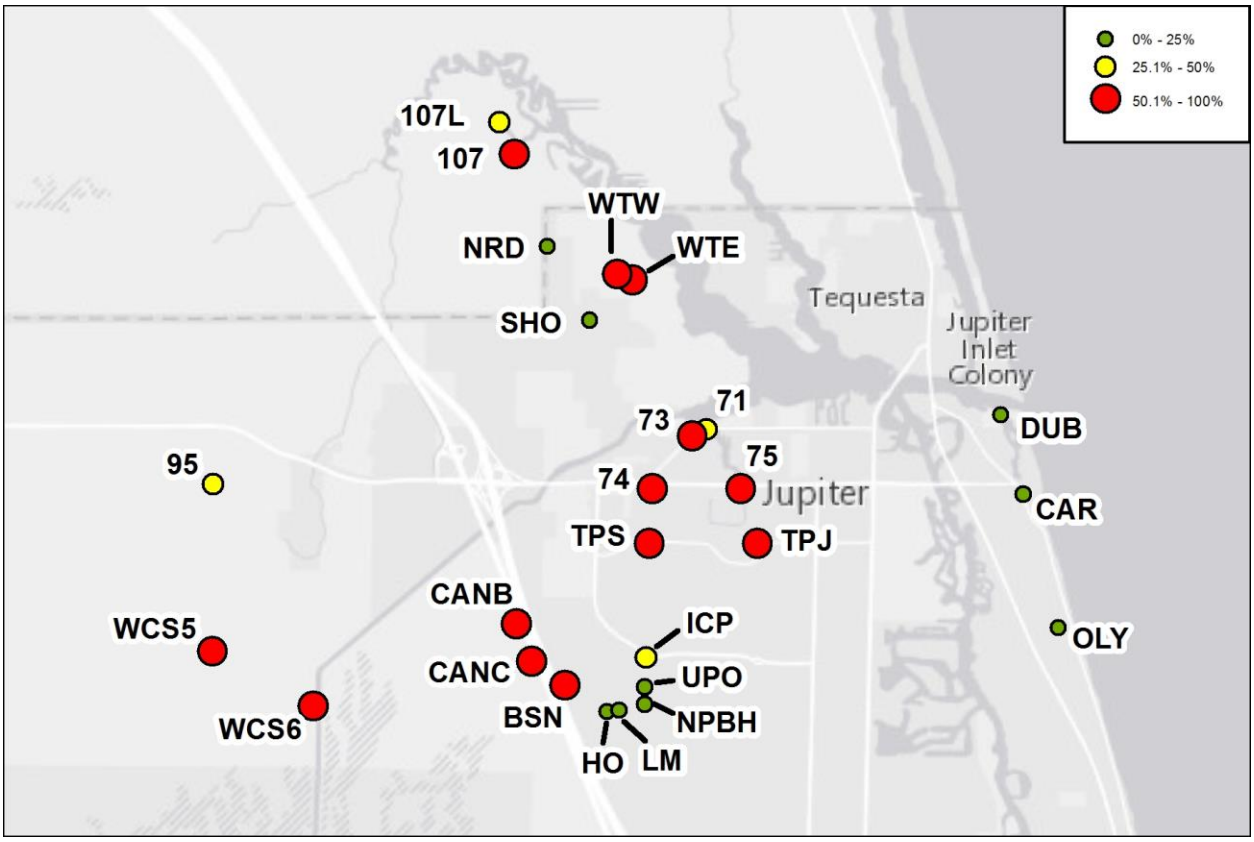


Figure 6. Map of the Loxahatchee River depicting sucralose concentrations at the different sucralose sampling locations (i.e., site IDs). Circles represent the percent of sucralose samples that had detectable sucralose concentrations present (>50 ng/L) for each sampling location, divided by the total sample size for that specific site. Increasing circle width represents increasing sucralose concentrations; color corresponds to sites that had "good" "poor" or "bad" sucralose concentrations, for instance, sites that had red circles had high sucralose concentrations.

## Conclusions

Ultimately, water quality in the Loxahatchee River suggests there may be some cause for concern. While several limit groups (e.g., marine, polyhaline, ICW-N and S) had equal to- or better-than target water quality conditions, many of the limit groups exceeded DEP/EPA NNC thresholds, particularly in the Southwest Fork and meso/oligohaline portions of the river. It is imperative that local agencies address the various point and non-point sources of nutrient pollution affecting these relatively degraded river reaches.

The Loxahatchee River has undergone many hydrological shifts, having largely deleterious effects on the ecological integrity of the river, such as driving saltwater intrusion (and associated mangrove encroachment), seagrass and oyster reef degradation, and reductions in water quality (VanArman et al. 2005). The RiverKeeper water quality monitoring program is an excellent and efficient approach to assess water quality in the Loxahatchee River watershed, and these data are useful in ranking turn-dirt projects to directly address impairments in the system. Because of LRD's long-standing commitment to evaluate water quality in the Loxahatchee River watershed, we have an unprecedented historical record against which present water quality conditions can be compared. As restoration efforts continue to move forward in the watershed, we will also continue to assess current water quality conditions and compare them against the established DEP/EPA NNC water quality thresholds, thereby providing a comprehensive measure of project success. Such spatial and temporal comparisons are invaluable when trying to adaptively manage our valuable natural resources.

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## Tables

Table 1. Active WildPine Laboratory RiverKeeper water quality station site IDs, site names, GPS coordinates, and EPA-DEP limit group designations. See Figure 1 for precise locations on a map.

| Site ID | Site Name | Lat | Long | Limit Group |
|---|---|---|---|---|
| WCS2 | SIRWCD # 2 | 26.932955 | -80.181205 | FW Canals |
| WCS3 | SIRWCD # 3 | 26.927306 | -80.191043 | FW Canals |
| WCS5 | SIRWCD # 5 | 26.912603 | -80.191353 | FW Canals |
| WCS6 | SIRWCD # 6 | 26.905248 | -80.176545 | FW Canals |
| WCS4 | SIRWCD # 4 | 26.919976 | -80.191125 | FW Canals |
| 10 | Jupiter Inlet | 26.945343 | -80.073821 | Marine |
| 20 | ICW - S.R. 707 | 26.953161 | -80.079006 | Marine |
| 25 | ICW - M.M. 43 | 27.00718 | -80.095373 | ICW-N |
| 30 | ICW - S.R. 706 | 26.932576 | -80.083153 | Marine |
| 32 | Burt Reynolds Park | 26.940651 | -80.08091 | Marine |
| 35 | ICW - D.Ross Rd. | 26.883168 | -80.069528 | ICW-S |
| 40 | River RR Track | 26.947391 | -80.092816 | Marine |
| 42 | Pennock Point | 26.950246 | -80.108791 | Polyhaline |
| 51 | NF - Tequesta Dr. | 26.957966 | -80.103743 | Polyhaline |
| 55 | NF - Countyline Rd. | 26.985308 | -80.114835 | Polyhaline |
| 56 | Papaya Village Outfall | 27.043692 | -80.135609 | FW Canals |
| 59 | NF - Bridge Rd. | 27.052426 | -80.147133 | FW Canals |
| 60 | NWF - Bay | 26.958051 | -80.120266 | Polyhaline |
| 62 | NWF - Islandway | 26.976293 | -80.131913 | Meso/Oligohaline |
| 63 | NWF - Osprey Nest | 26.987311 | -80.144268 | Meso/Oligohaline |
| 64 | NWF - JD Park Beach | 26.991116 | -80.145298 | Meso/Oligohaline |
| 65 | NWF - Kitching Cr. | 26.991145 | -80.155041 | Meso/Oligohaline |
| 66 | NWF - Hobe Groves | 26.985336 | -80.161803 | Wild & Scenic |
| 67 | NWF - Trapper's | 26.97601 | -80.163346 | Wild & Scenic |
| 68 | NWF - I - 95 | 26.954933 | -80.164355 | Wild & Scenic |
| 69 | NWF - S.R. 706 | 26.937315 | -80.176151 | Wild & Scenic |
| 71 | SF - Jones Cr. | 26.941608 | -80.118193 | Southwest Fork |
| 72 | SF - Lox. Riv. Rd. | 26.943301 | -80.121856 | Southwest Fork |
| 73 | SF - Sim's Cr. | 26.940723 | -80.120176 | Southwest Fork |
| 74 | SR 706 - Sim's Cr. | 26.9338 | -80.12624 | FW Tributaries |
| 75 | SR 706 - Jones Cr. | 26.933685 | -80.113126 | Southwest Fork |
| 81 | C18 - S.R. 706 | 26.933743 | -80.141791 | FW Tributaries |
| 86 | JCC OF 1 EAST | 26.92428 | -80.156863 | FW Tributaries |
| 87 | JCC OF 2 WEST | 26.916925 | -80.166731 | FW Tributaries |

| | | | | |
|---|---|---|---|---|
| 88 | JCC OF 3 NORTH | 26.942756 | -80.168376 | FW Tributaries |
| 92 | C14 - D. stream of G92 | 26.911321 | -80.175885 | FW Canals |
| 95 | Canal -1- J.Farms | 26.934731 | -80.191171 | FW Canals |
| 100 | Cypress - NWF | 26.977275 | -80.165971 | FW Tributaries |
| 101 | Jenkins Canal | 27.023808 | -80.165823 | FW Canals |
| 104 | Hobe Grove Canal | 26.985791 | -80.175003 | FW Canals |
| 105 | Cypress -Grove Canal | 26.97149 | -80.18865 | FW Canals |
| 106 | Kitching Creek | 26.994788 | -80.155136 | FW Tributaries |
| 107 | River's Edge Slough | 26.9782 | -80.14633 | Meso/Oligohaline |
| 107L | River's Edge Leg | 26.982458 | -80.148448 | Meso/Oligohaline |
| 107M | River's Edge Mouth | 26.979946 | -80.144013 | Meso/Oligohaline |
| 108 | Kitching Creek Flow Site | 27.011128 | -80.163691 | FW Tributaries |
| 111 | Kitch. Ck. @ 138 th. St. | 27.036385 | -80.165658 | FW Canals |
| 112 | Kitch. Ck. @ Bridge Rd. | 27.04378 | -80.167335 | FW Canals |

Table 2. Water quality parameters evaluated in the WildPine Laboratory, their unit of measurements, and standard methods used to analyze the samples. Note that all parameters are evaluated in the lab except for sucralose.

| Analyte | Unit of Measurement | Standard Method |
|---|---|---|
| Alkalinity as $CaC0_3$, titration | Milligrams/Liter | SM2320B |
| Ammonia N, FIA | Milligrams of N/Liter | SM4500-NH3G |
| Color | Platinum cobalt units (PCU) | SM20120B |
| Conductivity | Micromhos (1 ohm/centimeter) | EPA120.1 |
| Chlorophyll *a*, UV-VIS | Micrograms/Liter | SM10200H |
| Enterococcus, MF | Colony-forming unit (cfu)/100 milliliters | EPA1600 |
| Fecal Coliform, MF | Colony-forming unit (cfu)/100 milliliters | SM9222D |
| Total Kjehldahl Nitrogen, FIA | Milligrams of N/Liter | EPA351.2 |
| Nitrate + Nitrite N, FIA | Milligrams of N/Liter | EPA353.2 |
| Ortho-Phosphorus, FIA | Milligrams of P/Liter | SM 4500-P F |
| Sucralose | Nanograms/Liter | LC-MS-MS (processed by Eurofins) |
| Total Phosphorus, UV-VIS | Milligrams of P/Liter | SM4500-P E |
| Total Suspended Solids (TSS) | Milligrams/Liter | SM2540D |
| Turbidity | Nephelometric Turbidity Units (NTU) | EPA180.1 |

Table 3. WildPine Ecological Laboratory Sucralose sampling station site IDs, site names, GPS coordinates, EPA-DEP limit group designations, mean sucralose concentrations ± standard deviations (ng/L), and number of samples collected at each location. * Indicates that only one sample was taken at that site, and the raw data value is reported.

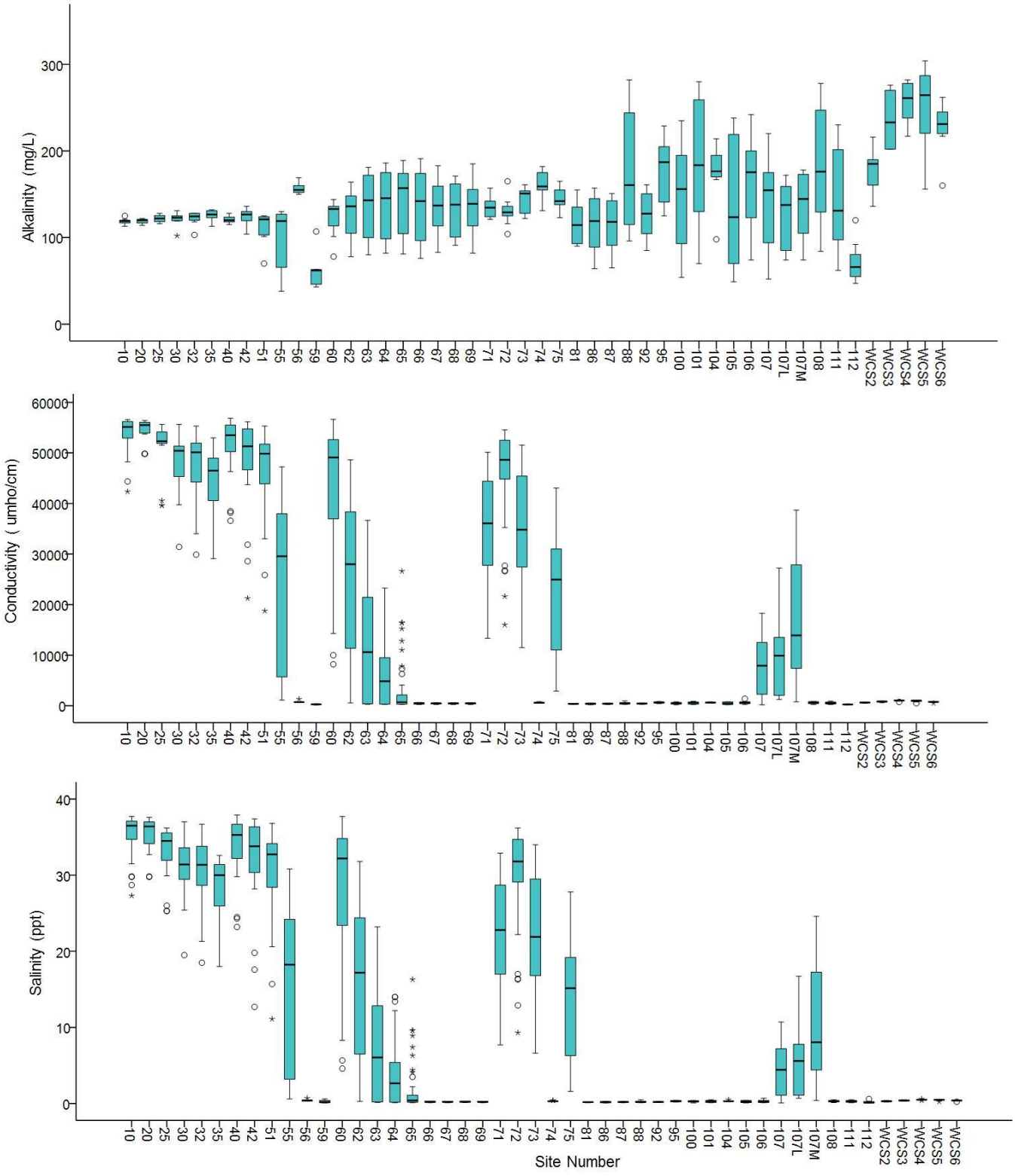
| Site ID | Site Name | Lat | Long | Limit Group | Sucralose concentrations | Sample Number |
|---|---|---|---|---|---|---|
| 95 | Canal -1- J.Farms | 26.934731 | -80.191171 | FW Canals | 140 ± 155.8 | 3 |
| 74 | SR 706 - Sim's Cr. | 26.9338 | -80.12624 | FW Tributaries | 2650 ± 2298.5 | 4 |
| 73 | SF - Sim's Cr. | 26.940723 | -80.120176 | Southwest Fork | 1791.6 ± 2157.3 | 6 |
| 71 | SF - Jones Cr. | 26.941608 | -80.118193 | Southwest Fork | 105 ± 77.7 | 2 |
| 107L | River's Edge Leg | 26.982458 | -80.148448 | Meso/Oligohaline | 135 ± 120.2 | 2 |
| 107 | River's Edge Slough | 26.9782 | -80.14633 | Meso/Oligohaline | 210 ± 202.9 | 10 |
| BSN | Basin in Egrets Landing W | 26.907762 | -80.139370 | FW Canals | *210 | 1 |
| CanB | Canal B Country Estates | 26.915971 | -80.146457 | FW Canals | 353.3 ± 271.1 | 3 |
| CanC | Canal C Country Estates | 26.911015 | -80.14424 | FW Canals | 305 ± 91.2 | 2 |
| Car | Carlin Park N Road Bridge | 26.932762 | -80.071407 | Marine | 50 ± 0 | 3 |
| Dub | Dubois Swim Area | 26.943172 | -80.074526 | Marine | 50 ± 0 | 3 |
| HO | Heights Outfall | 26.904225 | -80.133080 | FW Canals | 50 ± 0 | 2 |
| ICP | Indian Creek Parkway | 26.911368 | -80.1272771 | FW Canals | 2525 ± 3500.1 | 2 |
| L&M | Lat Canal at L & M Heights | 26.904450 | -80.1313480 | FW Canals | *50 | 1 |
| NPBH | So Corner of Sims Canal | 26.905185 | -80.127541 | FW Canals | *50 | 1 |
| NRD | North River Drive | 26.96594 | -80.141505 | FW Canals | 50 ± 0 | 2 |
| Oly | Olympus S Lake | 26.914941 | -80.066319 | FW Canals | *50 | 1 |
| Sho | Shores E-W Lake | 26.956191 | -80.135295 | FW Canals | 50 ± 0 | 2 |
| TPS | Sims @ Toney Penna | 26.926531 | -80.126651 | FW Canals | *4800 | 1 |
| UPO | Upstream of Egrets Outfall | 26.907532 | -80.127554 | FW Canals | *50 | 1 |
| WCS5 | SIRWCD # 5 | 26.912603 | -80.191353 | FW Canals | 550 ± 326.0 | 3 |
| WCS6 | SIRWCD # 6 | 26.905248 | -80.176545 | FW Canals | 273.3 ± 96.0 | 3 |
| WTE | Whispering Trails East | 26.961516 | -80.128886 | FW Canals | 1290 ± 1004.0 | 2 |
| WTW | Whispering Trails West | 26.962231 | -80.131105 | FW Canals | 810 ± 551.5 | 2 |

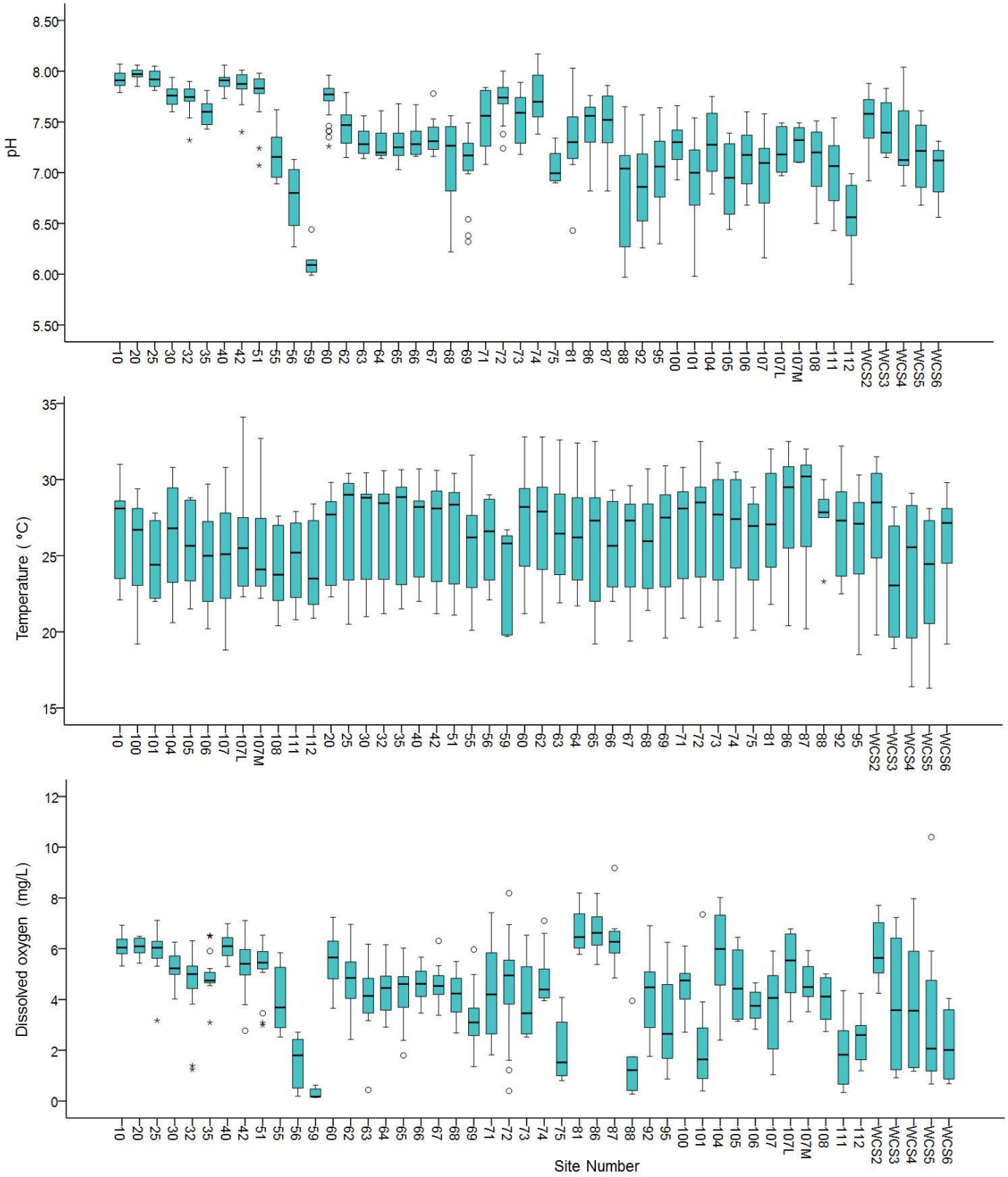
Table 4. Independent samples t-test table output comparing chlorophyll *a*, total phosphorus, and total nitrogen mean concentrations in station 72 and 81. Table includes the degrees of freedom, and mean concentrations ± standard deviation.

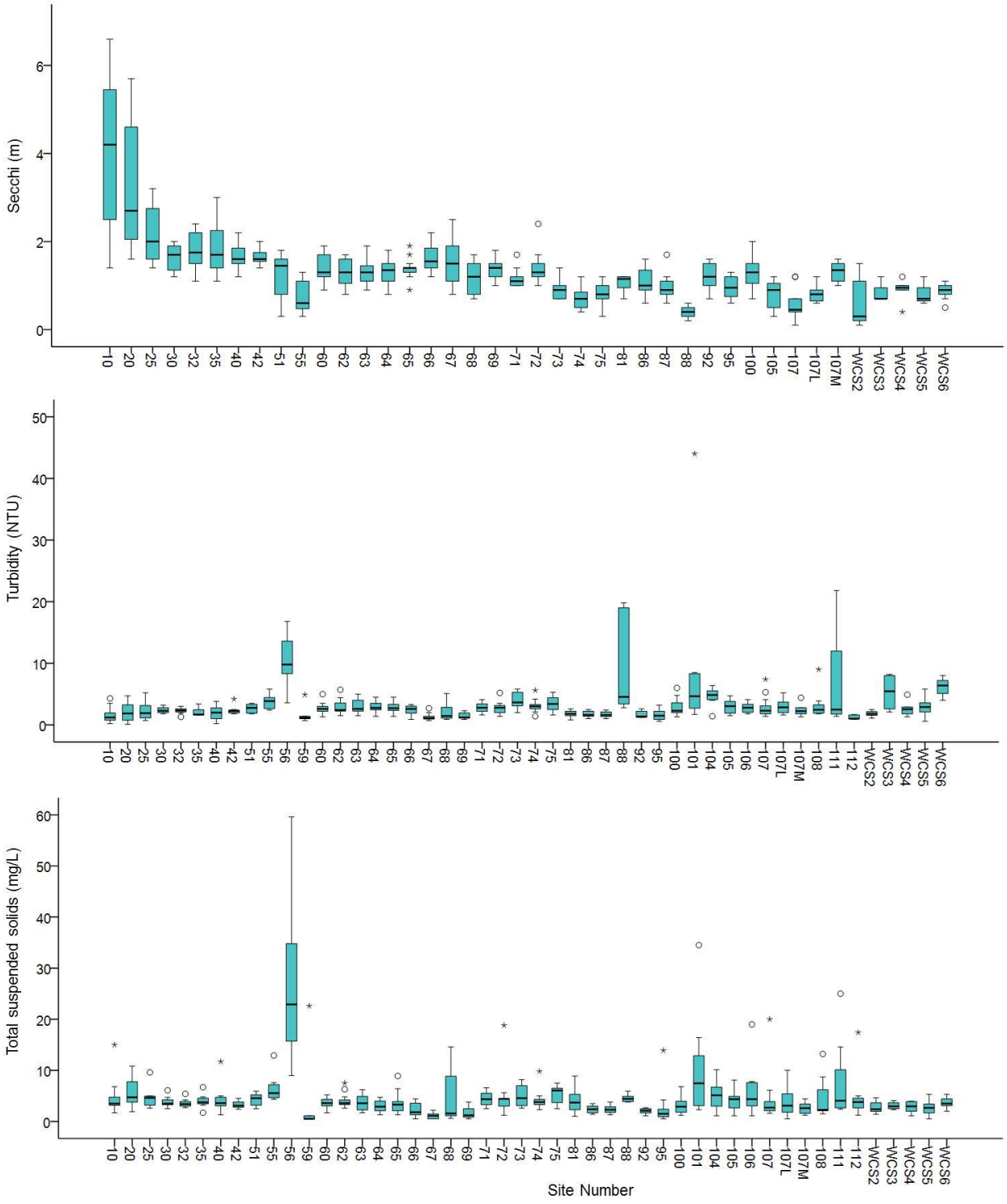
| Nutrient Parameter for Station 72 and 81 | Degrees of freedom | Mean ± SD | T statistic | P value |
|---|---|---|---|---|
| Chlorophyll *a* (ug/L) | 166 | | 2.40 | 0.01 |
| 72 | | 13.1 ± 12.5 | | |
| 81 | | 8.6 ± 9.5 | | |
| Total phosphorus (mg-P/L) | 169 | | 4.43 | 0.000 |
| 72 | | 0.03 ± 0.01 | | |
| 81 | | 0.02 ± 0.01 | | |
| Total nitrogen (mg-N/L) | 169 | | -9.1 | 0.000 |
| 72 | | 0.57 ± 0.25 | | |
| 81 | | 0.99 ± 0.32 | | |

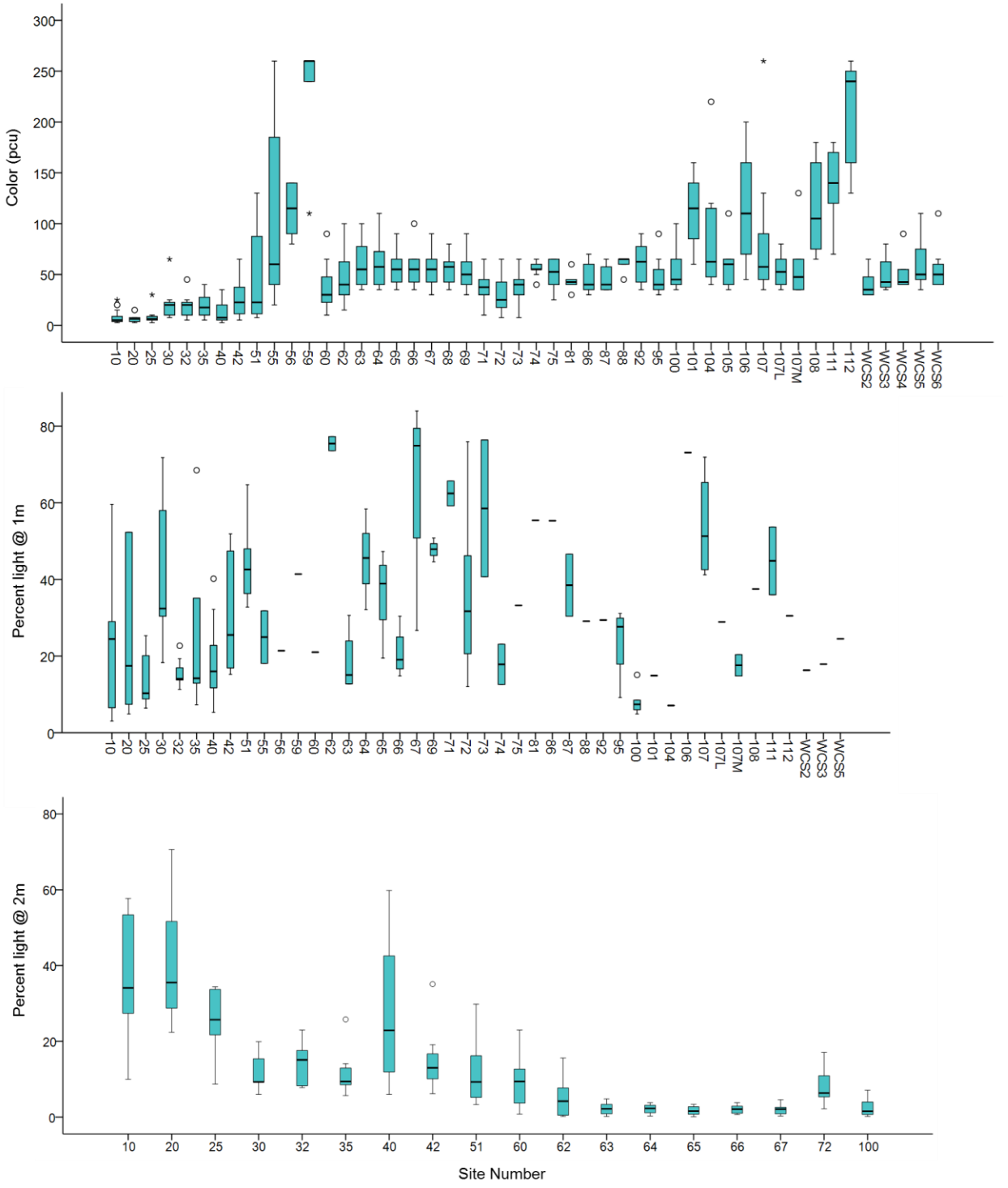
# Appendix A

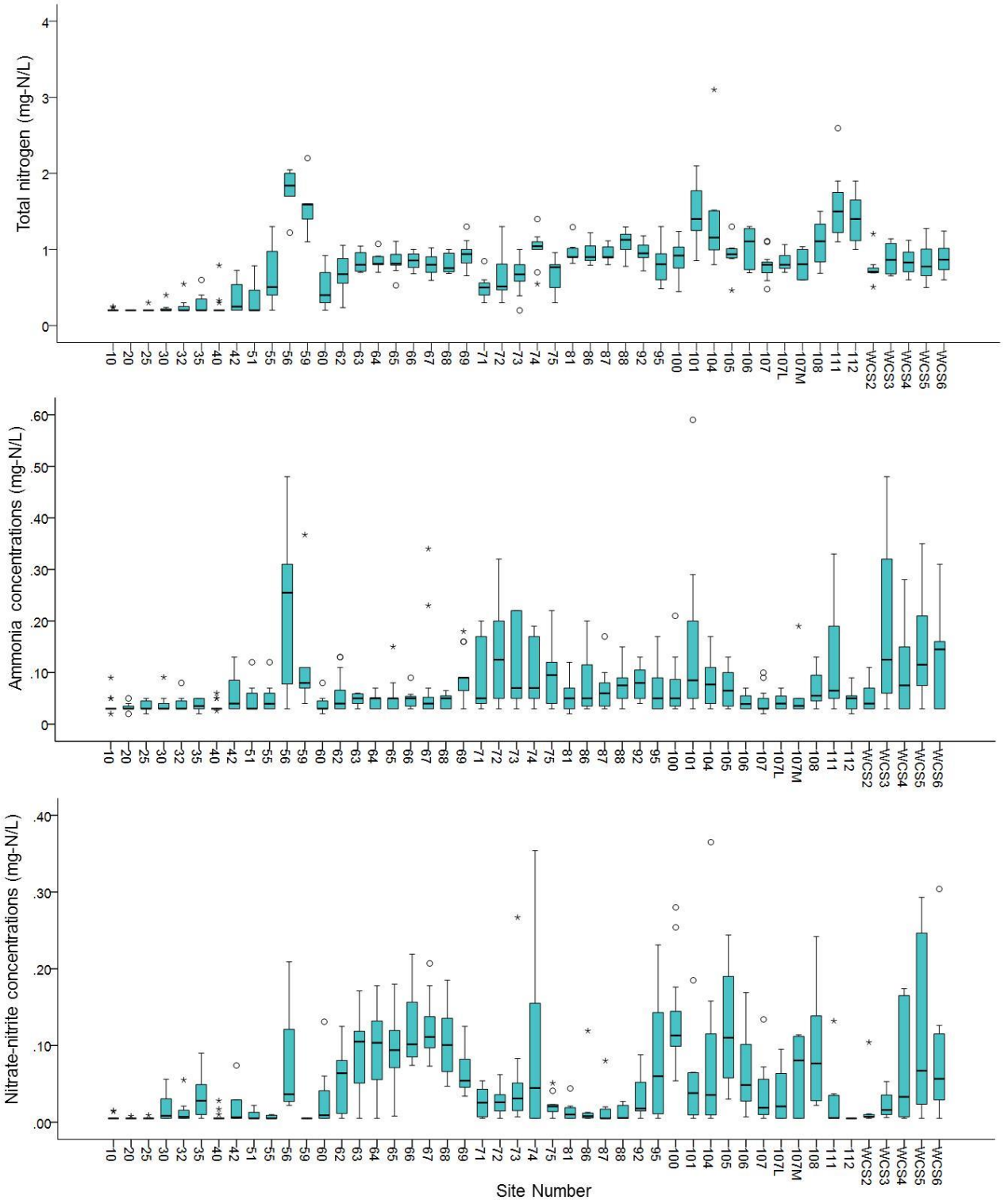
RiverKeeper water quality parameters across all sampling stations for July 2014-September 2015

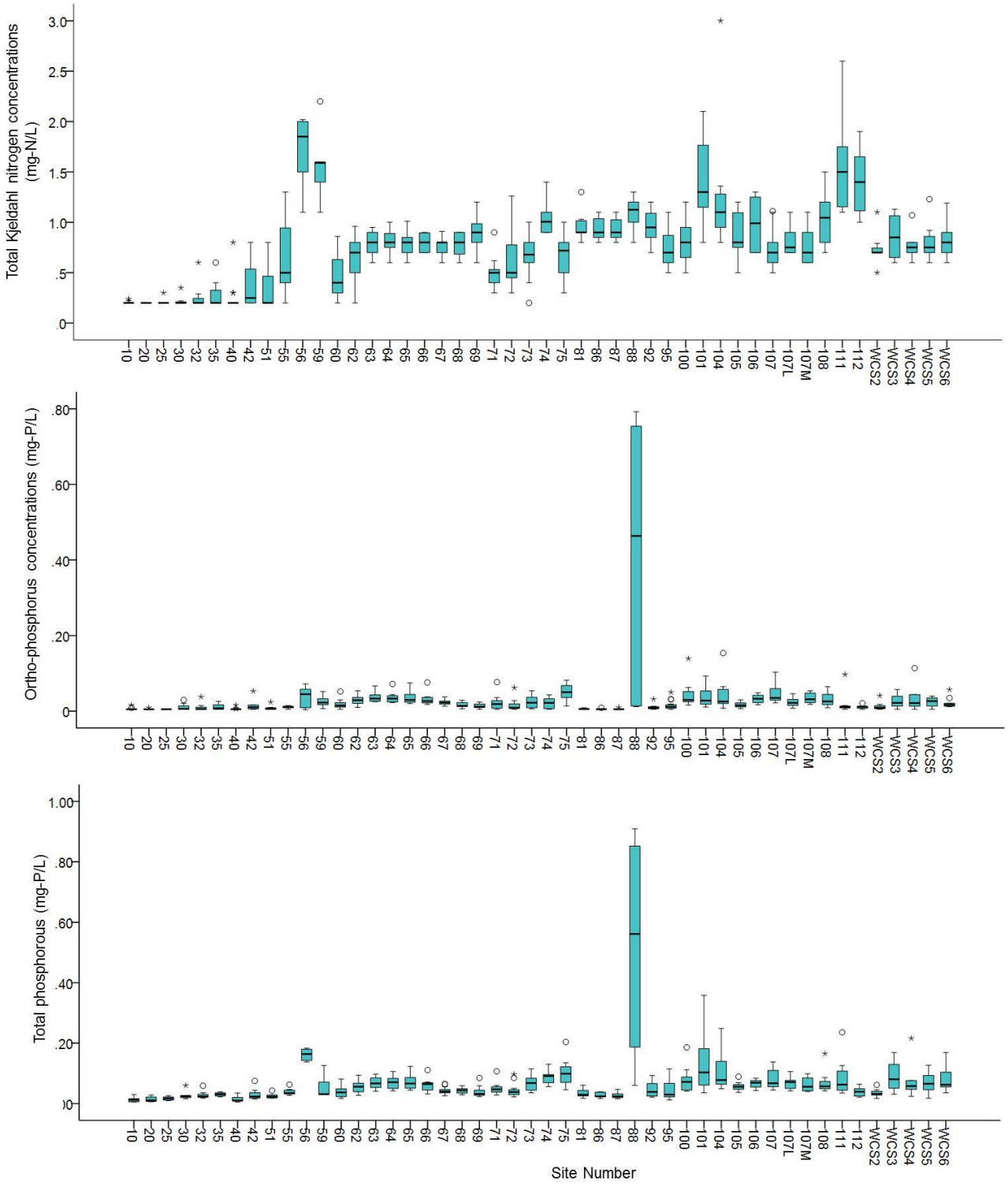

Alkalinity (mg/L)
0
100
200
300
Conductivity ( umho/cm)
0
10000
20000
30000
40000
50000
60000
Salinity (ppt)
0
10
20
30
40
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6
Site Number

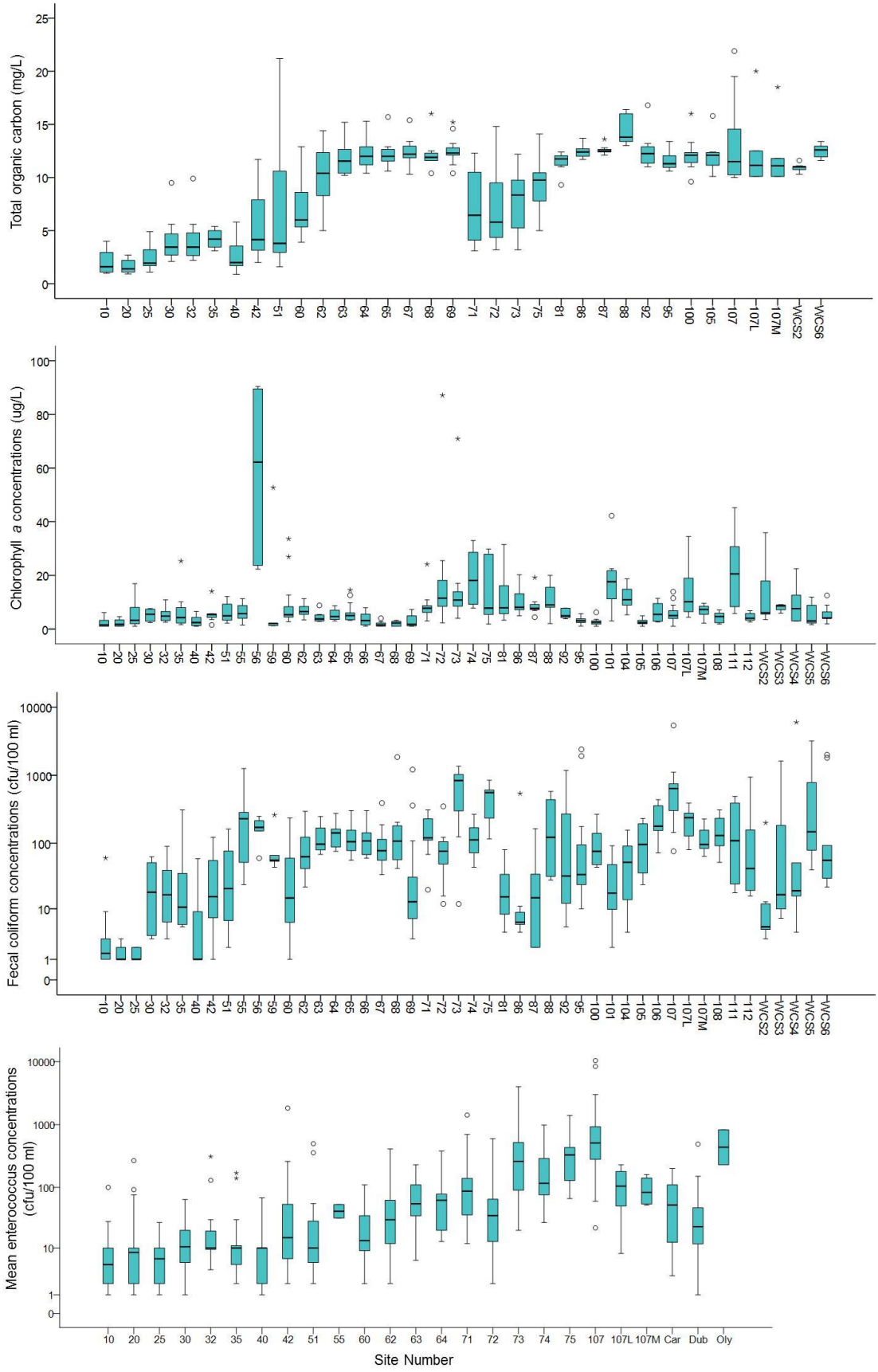

pH
8.50
8.00
7.50
7.00
6.50
6.00
5.50
Temperature ( °C)
35
30
25
20
15
Dissolved oxygen (mg/L)
12
10
8
6
4
2
0
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6
Site Number


Secchi (m)
0
2
4
6
10 20 25 30 32 35 40 42 51 55 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 105 107 107L 107M WCS2 WCS3 WCS4 WCS5 WCS6
Turbidity (NTU)
0
10
20
30
40
50
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6
Total suspended solids (mg/L)
0
10
20
30
40
50
60
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6
Site Number


Color (pcu)
Percent light @ 1m
Percent light @ 2m
Site Number

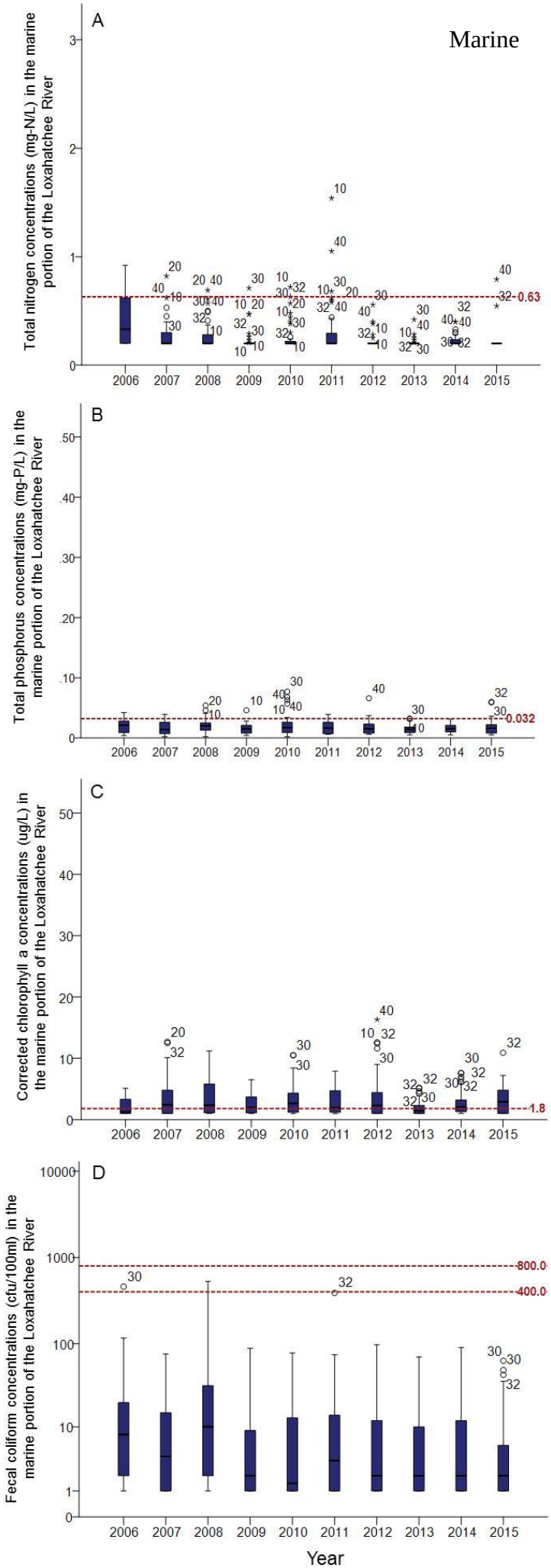

Total nitrogen (mg-N/L)
Ammonia concentrations (mg-N/L)
Nitrate-nitrite concentrations (mg-N/L)
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6
Site Number


Total Kjeldahl nitrogen concentrations (mg-N/L)
Ortho-phosphorus concentrations (mg-P/L)
Total phosphorous (mg-P/L)
Site Number
10 20 25 30 32 35 40 42 51 55 56 59 60 62 63 64 65 66 67 68 69 71 72 73 74 75 81 86 87 88 92 95 100 101 104 105 106 107 107L 107M 108 111 112 WCS2 WCS3 WCS4 WCS5 WCS6


Total organic carbon (mg/L)
Chlorophyll a concentrations (ug/L)
Fecal coliform concentrations (cfu/100 ml)
Mean enterococcus concentrations (cfu/100 ml)
Site Number

# Appendix B

Water quality trends for total nitrogen, total phosphorus, chlorophyll *a*, and bacteria concentrations for all limit groups from 2006-2015



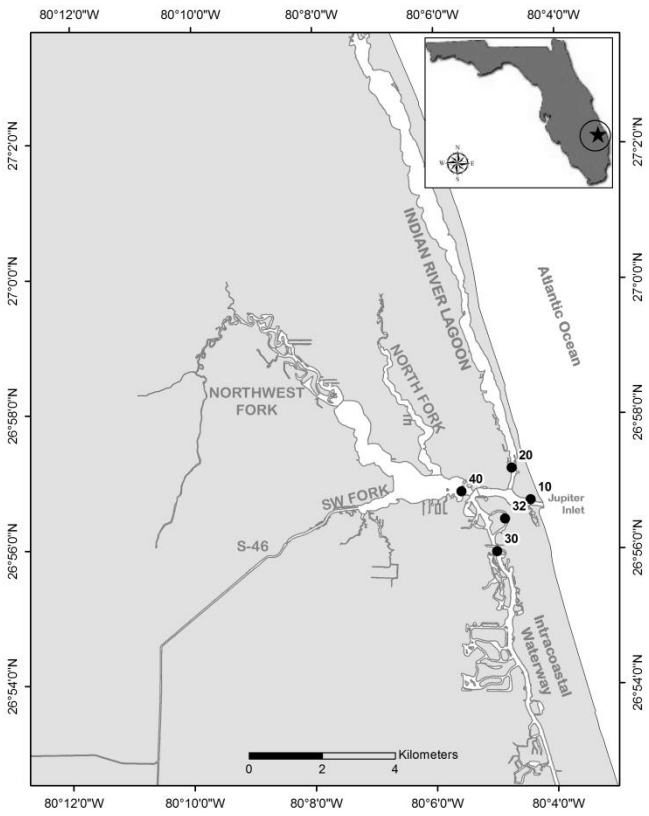
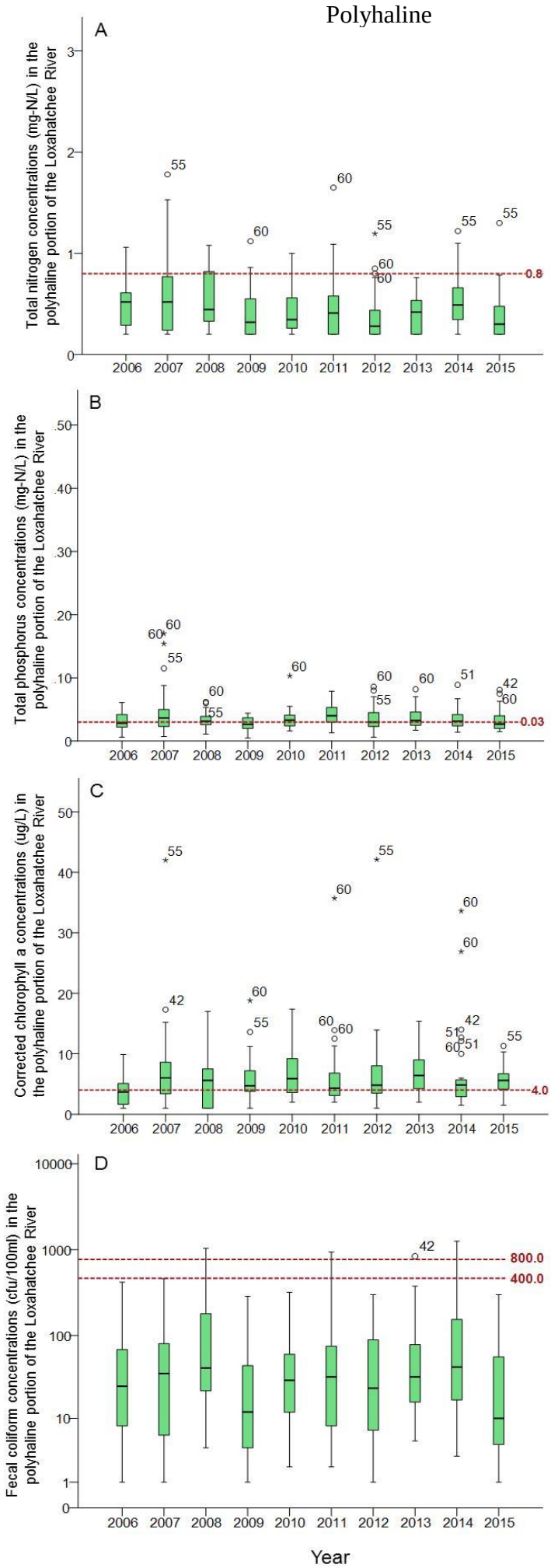




Figure B1- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in marine waters. Each sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for marine waters. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In marine waters, water quality has typically remained good over the last decade; flushing from the nearby Jupiter Inlet is likely responsible for low nutrient concentrations. Chlorophyll *a* concentrations have exceeded the stringent NNC threshold in almost every year, but not substantially, and the threshold is very low (1.8 ug/L).



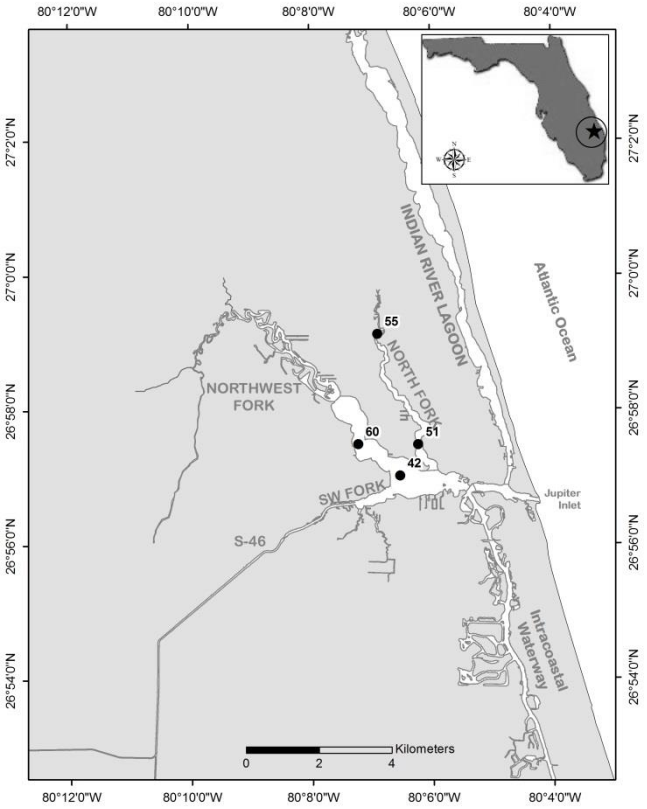
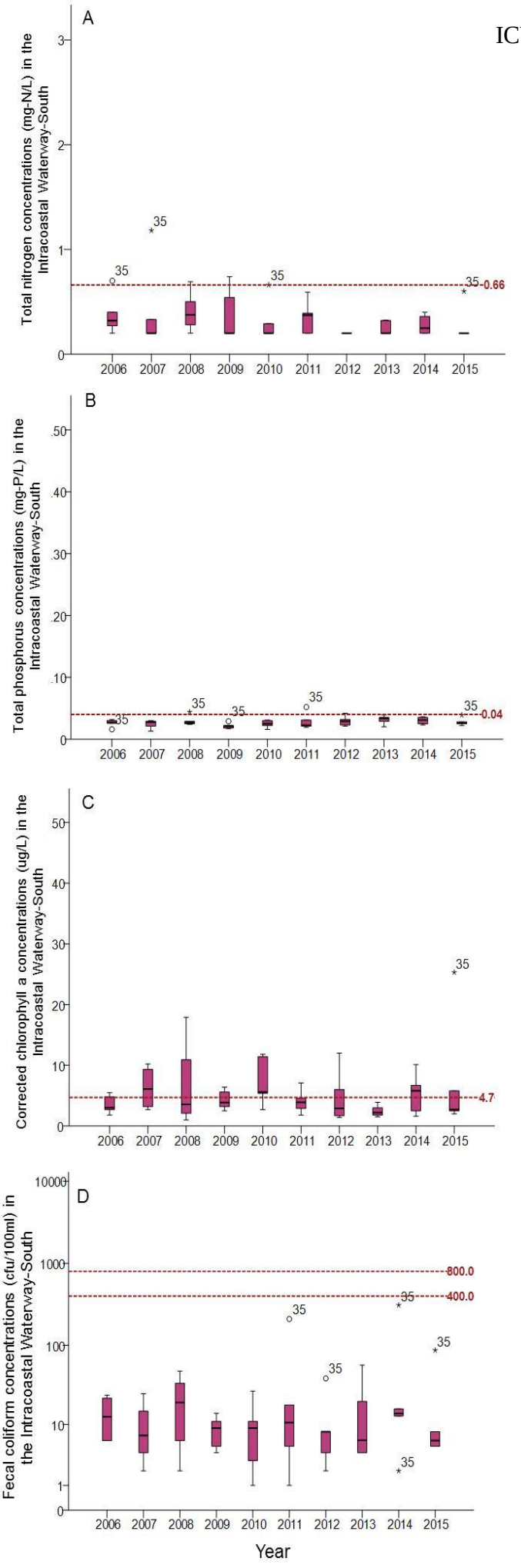




Figure B2- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in polyhaline waters. Each sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for polyhaline waters. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In polyhaline waters, water quality has typically remained good over the last decade. Though chlorophyll *a* concentrations have exceeded the stringent NNC threshold in almost every year, the threshold is low (4.0 ug/L).



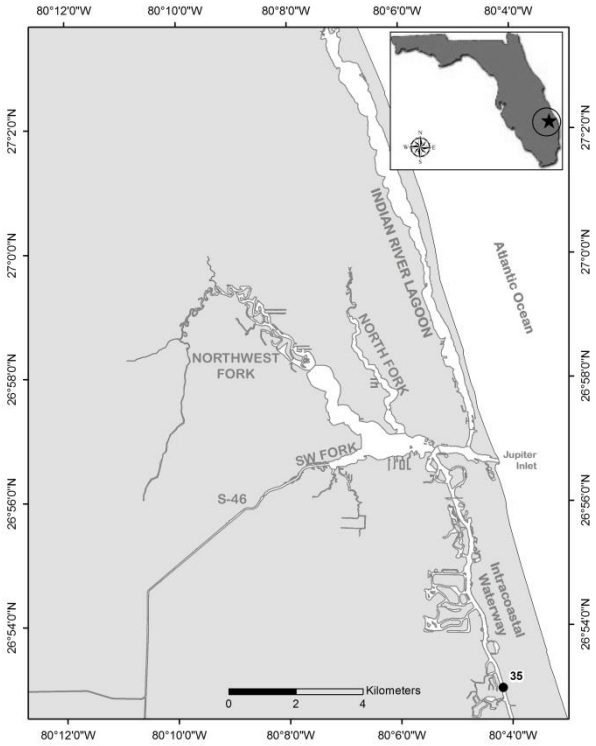
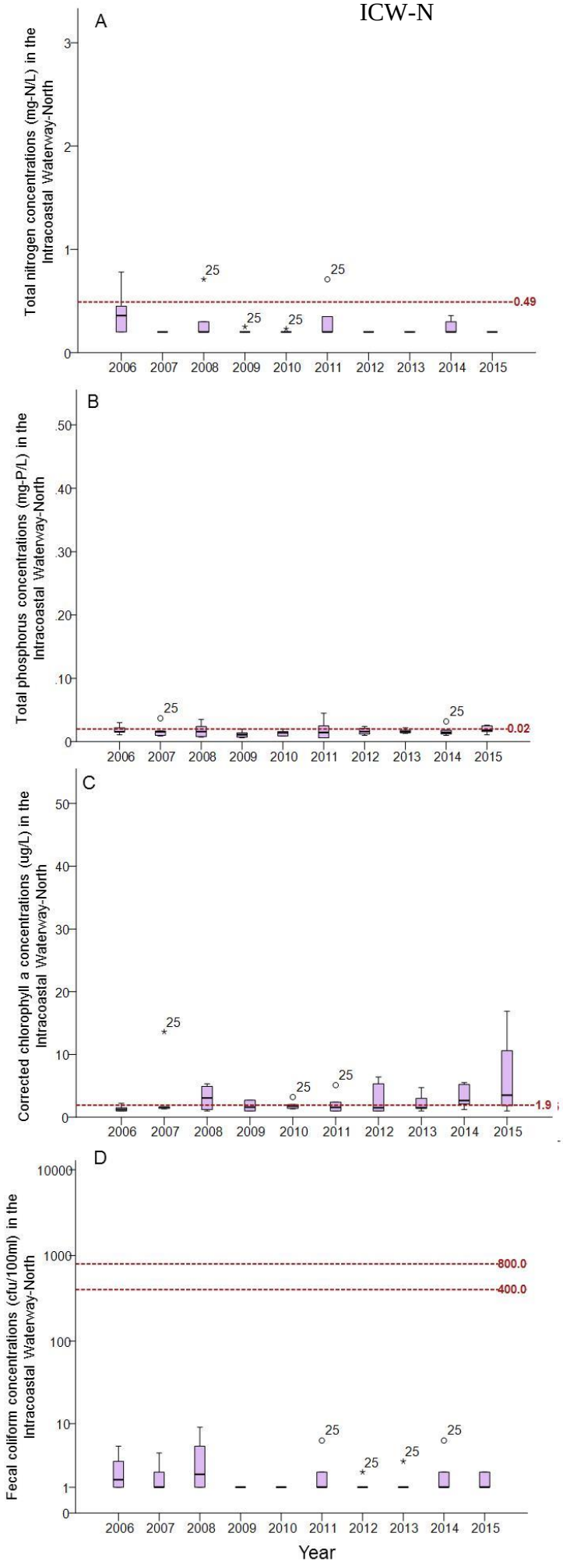




Figure B3- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in the Intracoastal Waterway-South (ICW-S). The sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for the ICW-S. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In the ICW-S, water quality has typically remained good over the last decade, possibly in part because this brackish water is well-flushed. Chlorophyll *a* concentrations have exceeded the NNC threshold in almost every year, but not substantially, and the threshold is low (4.7 ug/L).



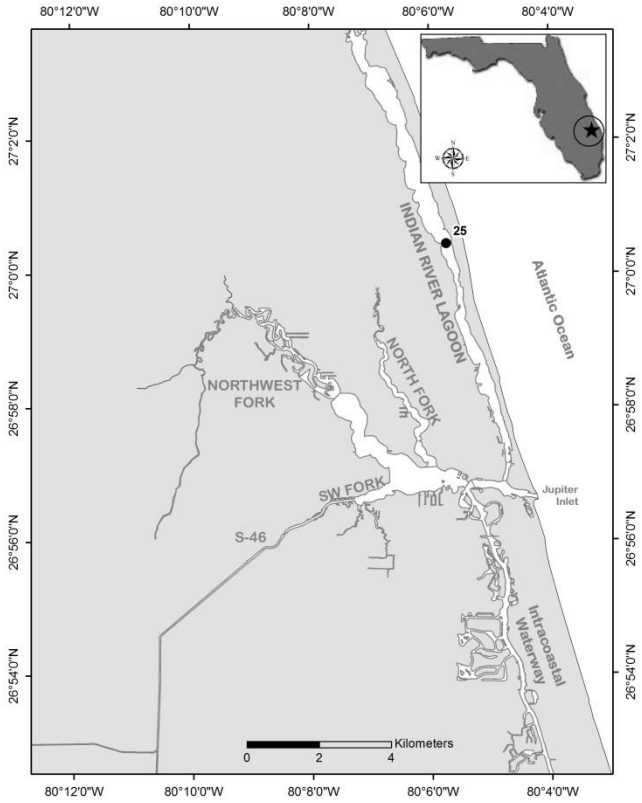




Figure B4- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in the Intracoastal Waterway-North (ICW-N). The sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for the ICW-N. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

Water quality in the ICW-N mirrors water quality in the ICW-S; it has consistently been good over the last decade. Chlorophyll *a* concentrations have been apparently increasing over the last five years, though it is unclear as to what is driving this trend.

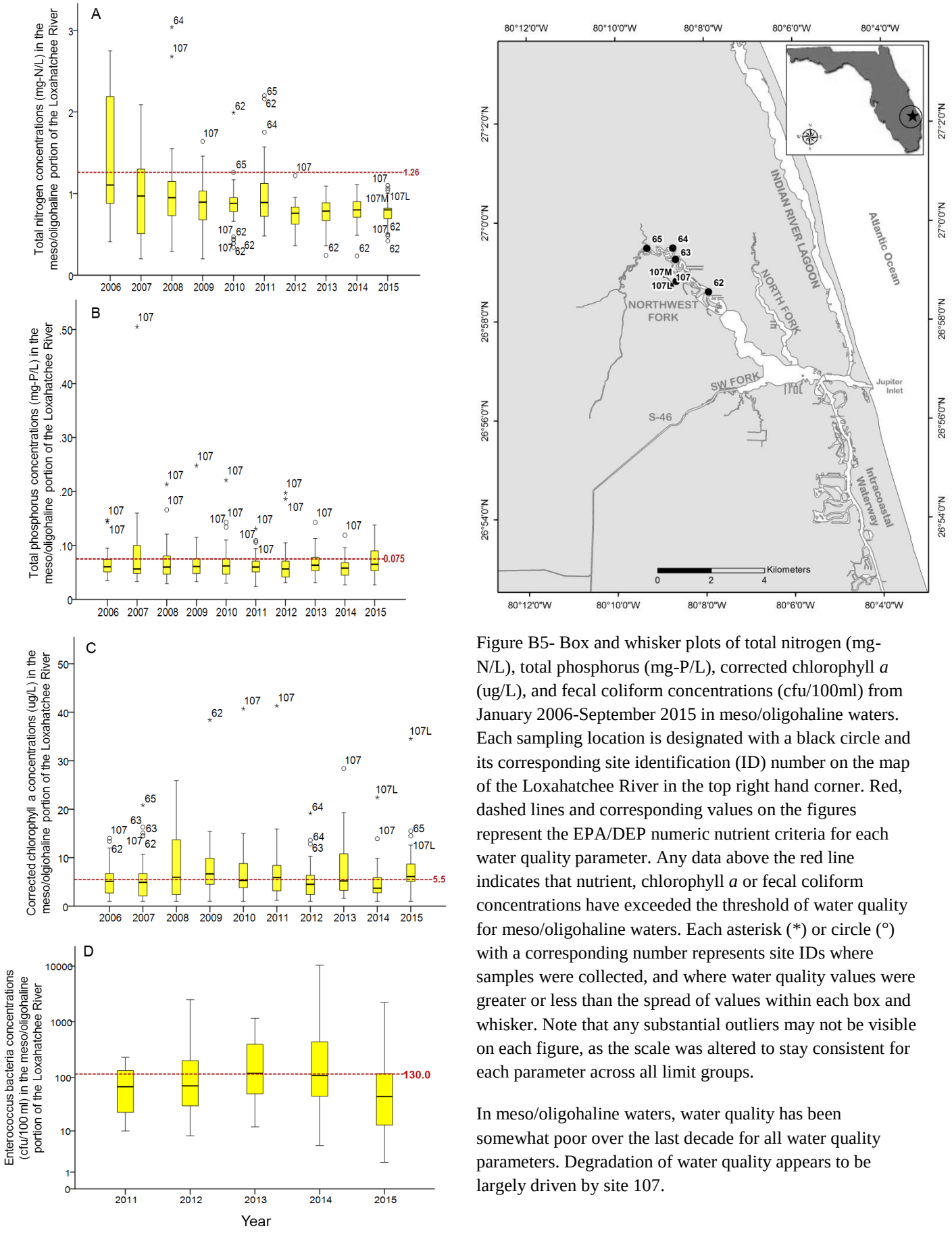
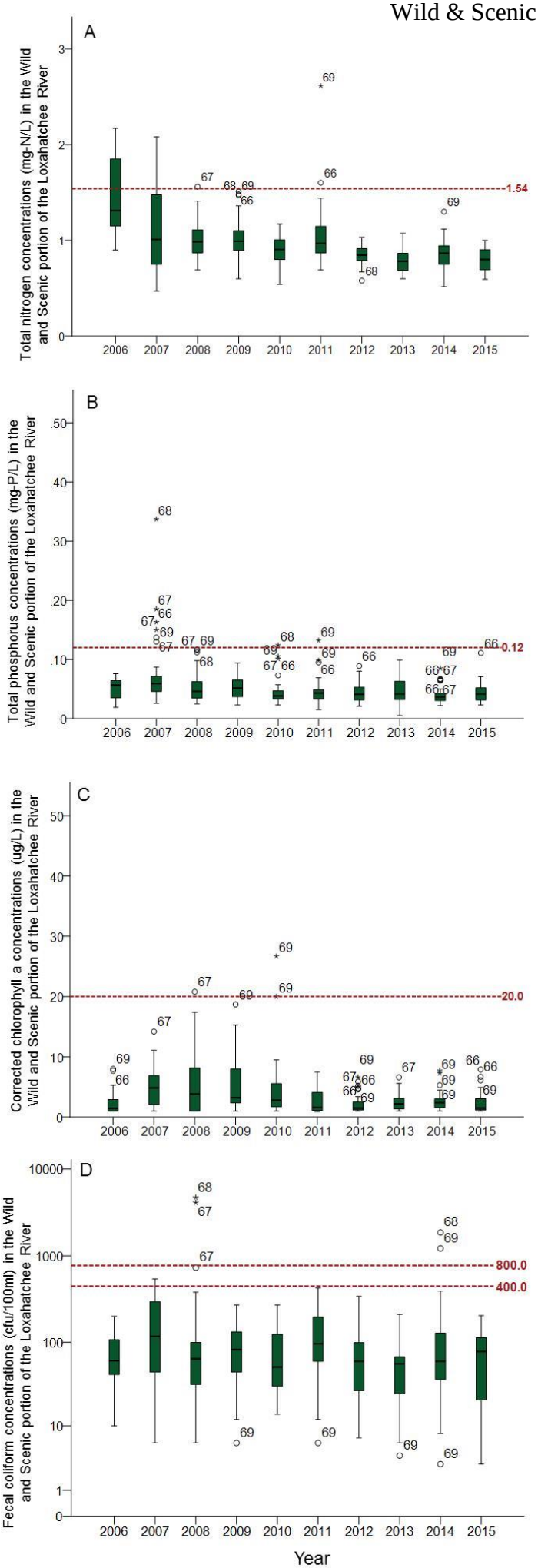



Figure B5- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in meso/oligohaline waters. Each sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for meso/oligohaline waters. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In meso/oligohaline waters, water quality has been somewhat poor over the last decade for all water quality parameters. Degradation of water quality appears to be largely driven by site 107.



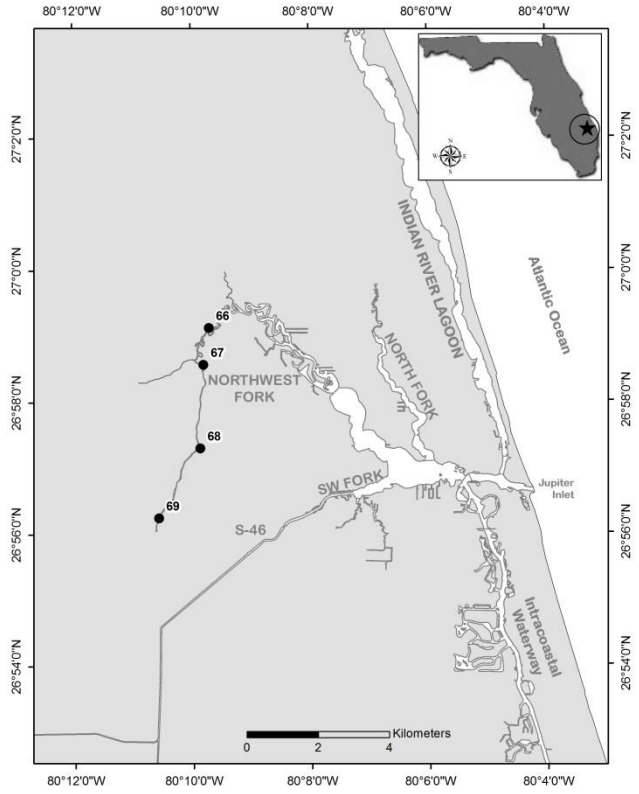
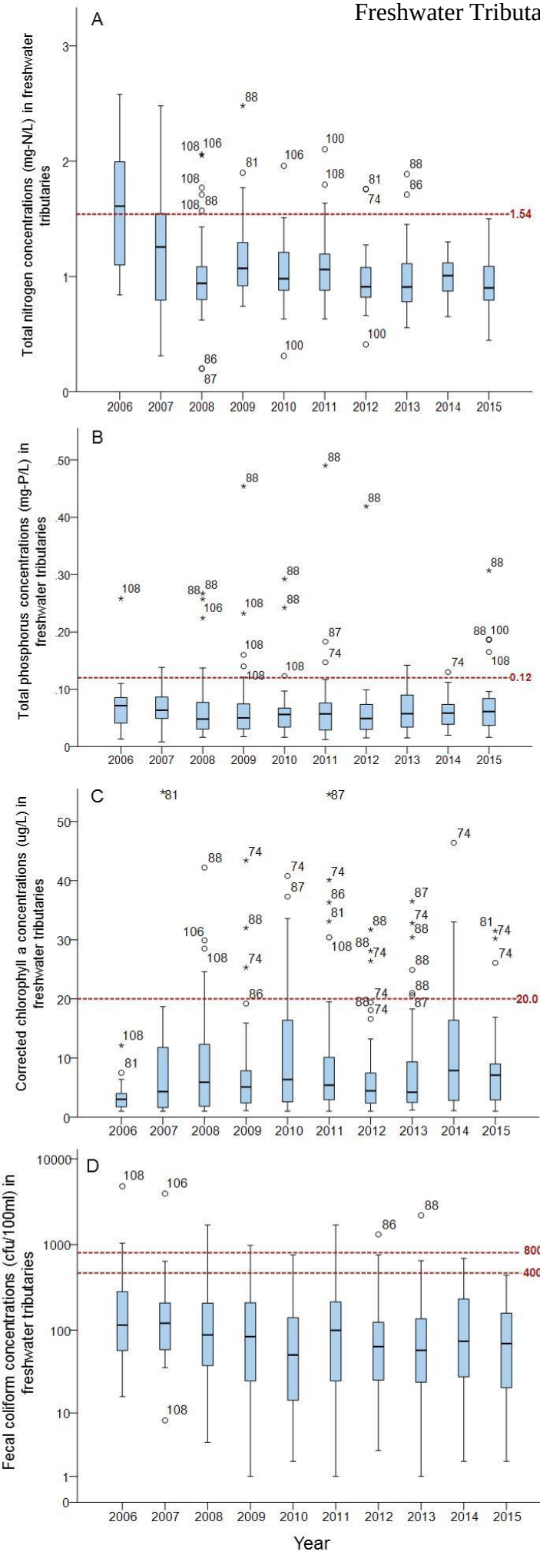




Figure B6- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in the Wild and Scenic portion of the Loxahatchee River estuary. Each sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for the Wild and Scenic portion of the river. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In the Wild and Scenic portion of the river, water quality has typically remained good over the last decade, falling below the NNC for all parameters. Site 69 has occasionally had slightly higher nutrient and chlorophyll *a* concentrations indicated by asterisks, likely due to poor water quality being discharged from the Jupiter Farms surface water canal drainage system.



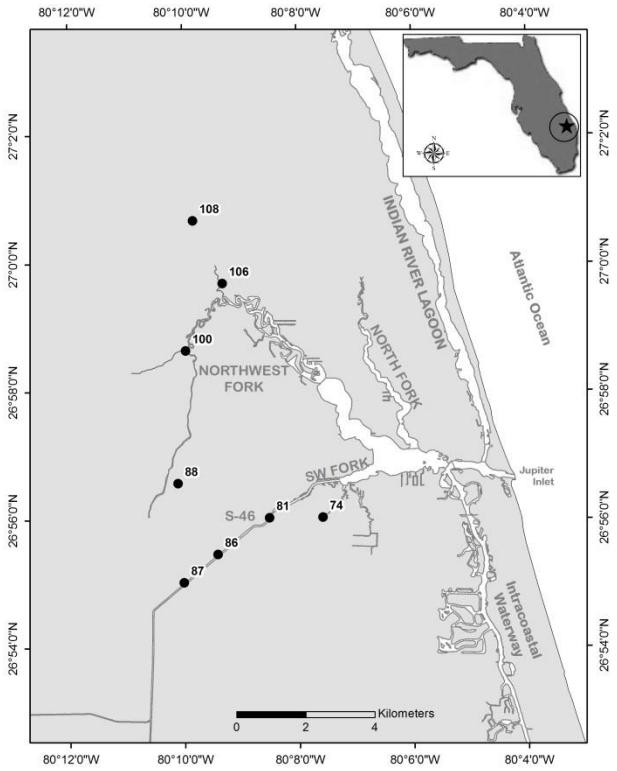
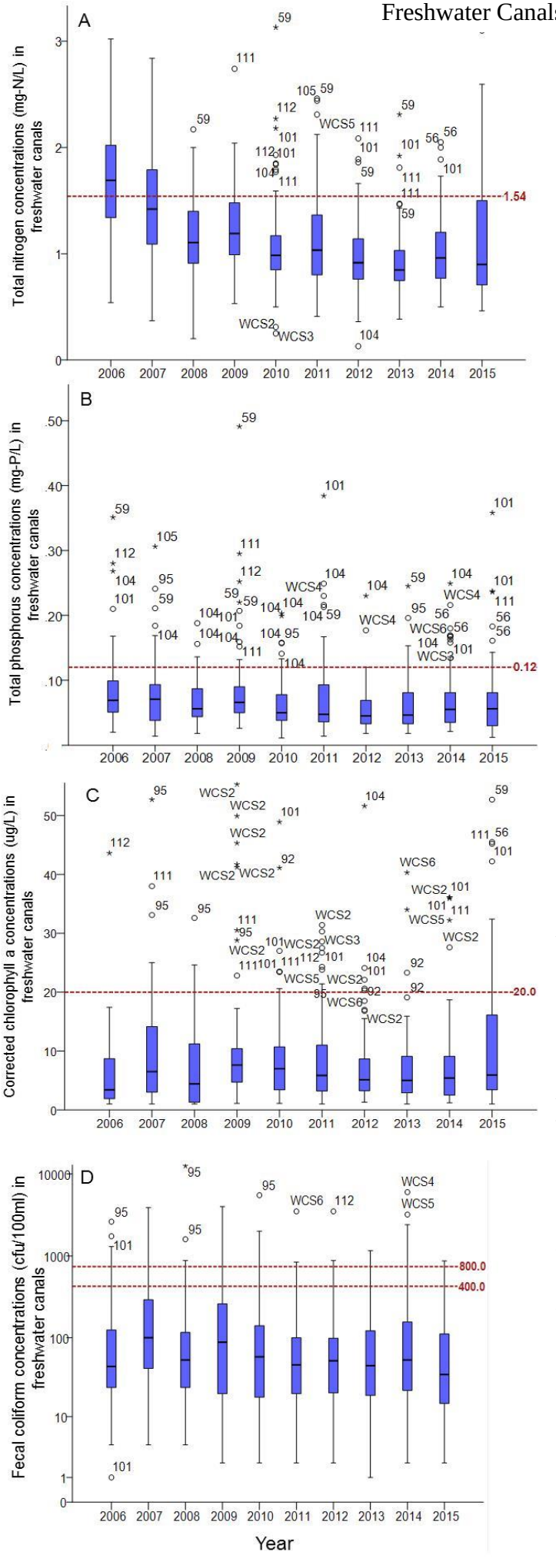




Figure B7- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in freshwater tributaries in the Loxahatchee River estuary. Each freshwater tributary sampled is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for freshwater tributaries. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In the freshwater tributaries, nutrient, chlorophyll *a*, and fecal coliform concentrations tended to fall below the NNC threshold. However, total phosphorus concentrations were elevated from 2008-2014, largely driven by poor water quality in site 88, the outfall from a former agriculture site. This was likely a result of construction activities occurring adjacent to this site.



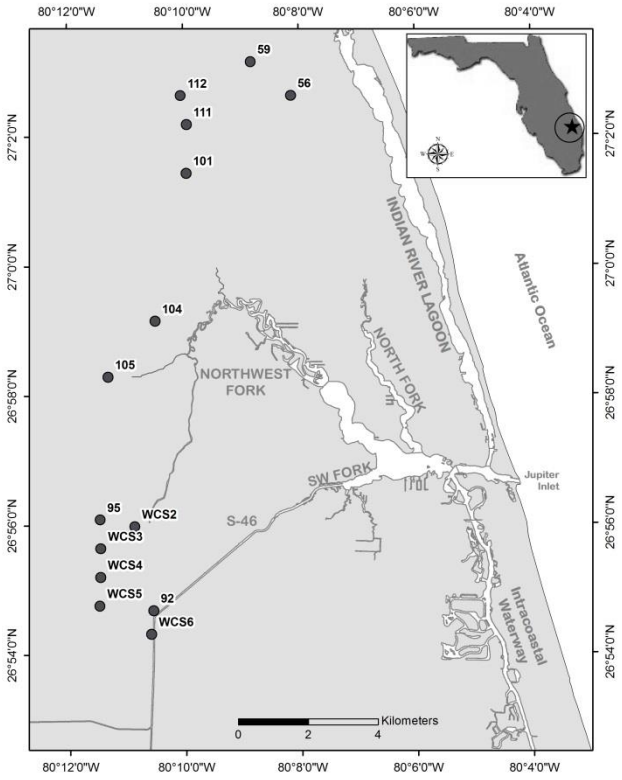
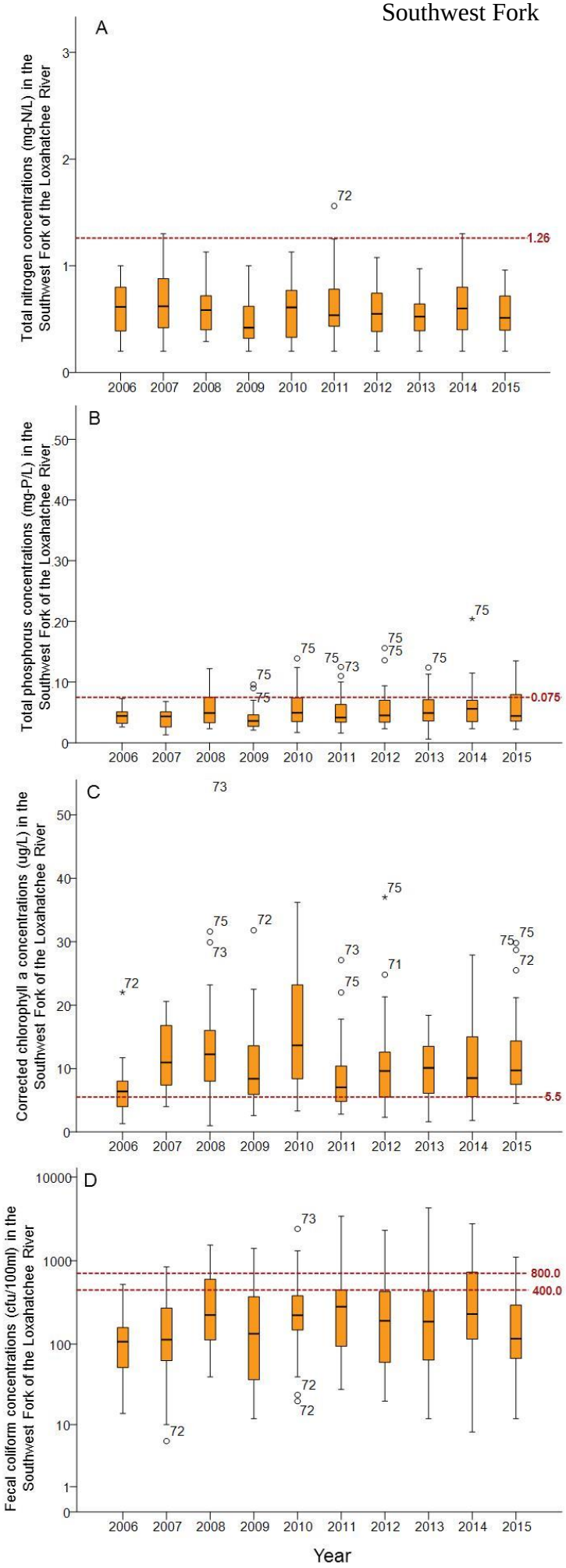




Figure B8- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in freshwater canals in the Loxahatchee River estuary. Each freshwater canal sampled is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for freshwater canals. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

In the freshwater canals, total nitrogen concentrations have been slightly elevated, occasionally surpassing the NNC, over the last decade. Specifically, canals adjacent to or in Jonathan Dickinson State Park (sites 56, 59, 101, 111, 112) have been high, likely as a result of varied agricultural practices in the area, and possibly runoff from upstream golf course communities (site 56) or adjacent roadside ditch.



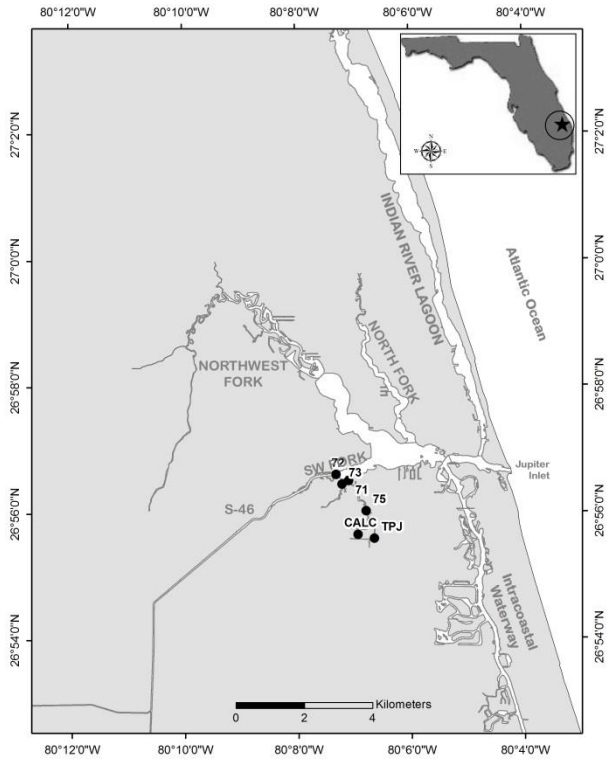




Figure B9- Box and whisker plots of total nitrogen (mg-N/L), total phosphorus (mg-P/L), corrected chlorophyll *a* (ug/L), and fecal coliform concentrations (cfu/100ml) from January 2006-September 2015 in the Southwest Fork of the Loxahatchee River estuary. Each sampling location is designated with a black circle and its corresponding site identification (ID) number on the map of the Loxahatchee River in the top right hand corner. Red, dashed lines and corresponding values on the figures represent the EPA/DEP numeric nutrient criteria for each water quality parameter. Any data above the red line indicates that nutrient, chlorophyll *a* or fecal coliform concentrations have exceeded the threshold of water quality for the Southwest Fork. Each asterisk (*) or circle (°) with a corresponding number represents site IDs where samples were collected, and where water quality values were greater or less than the spread of values within each box and whisker. Note that any substantial outliers may not be visible on each figure, as the scale was altered to stay consistent for each parameter across all limit groups.

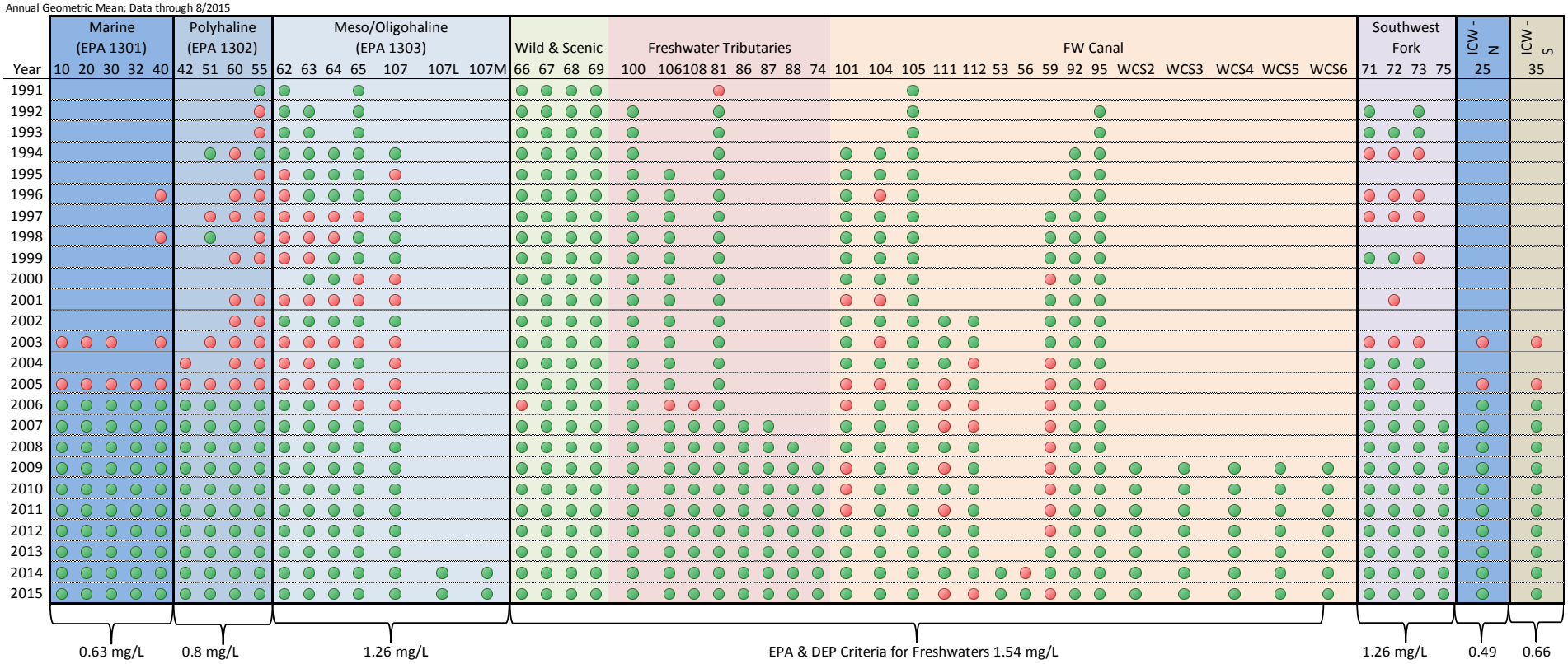
The Southwest Fork has been an area of concern over the last decade, with elevated chlorophyll *a*, total phosphorus, and fecal coliform concentrations. Chlorophyll *a* has routinely exceeded the stringent NNC threshold of 5.5 ug/L, possibly due to stagnant water that accumulates when the S-46 flood control structure is closed, though further work is necessary to identify specific mechanisms driving these patterns.

# Appendix C

Stoplight water quality charts for total nitrogen, total phosphorus, chlorophyll *a*, and fecal coliform concentrations across all limit groups from 1991-2015

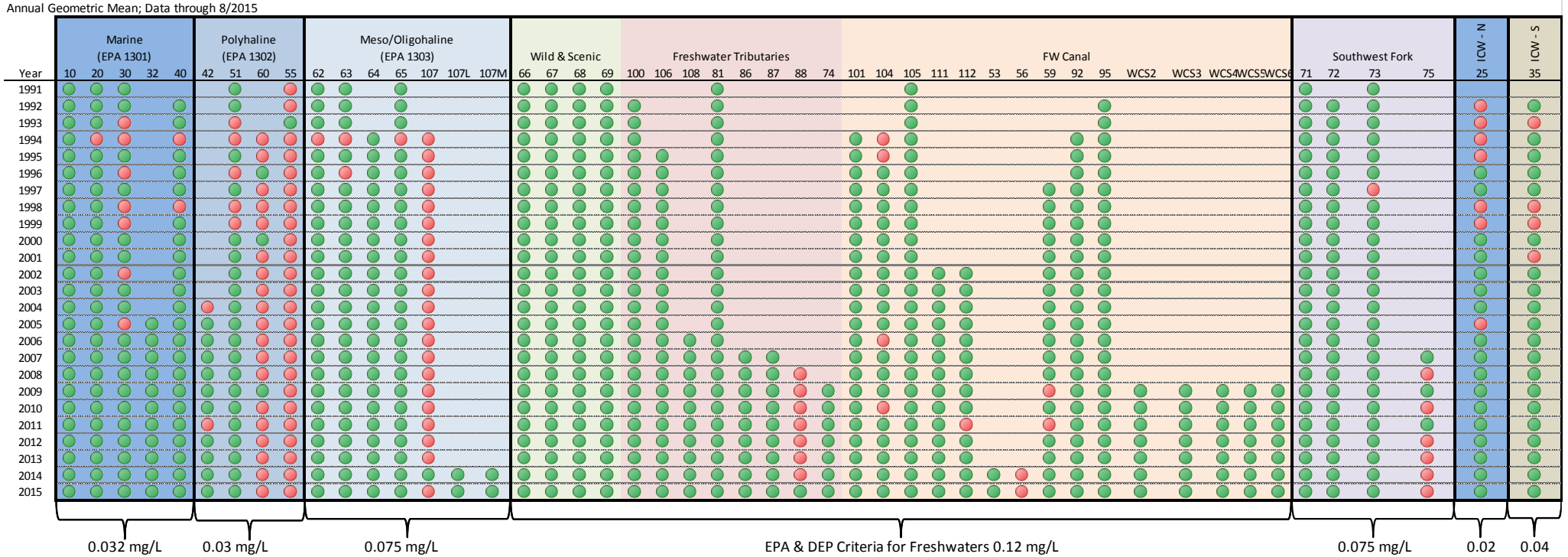
# Total Nitrogen

Annual Geometric Mean; Data through 8/2015



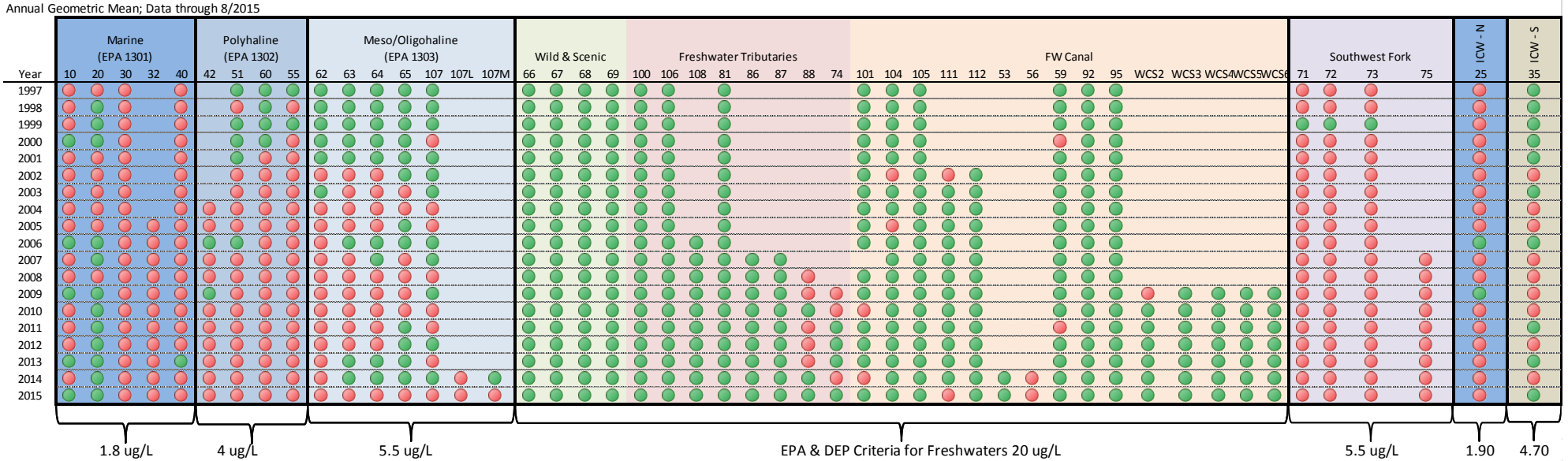
# Total Phosphorus

Annual Geometric Mean; Data through 8/2015



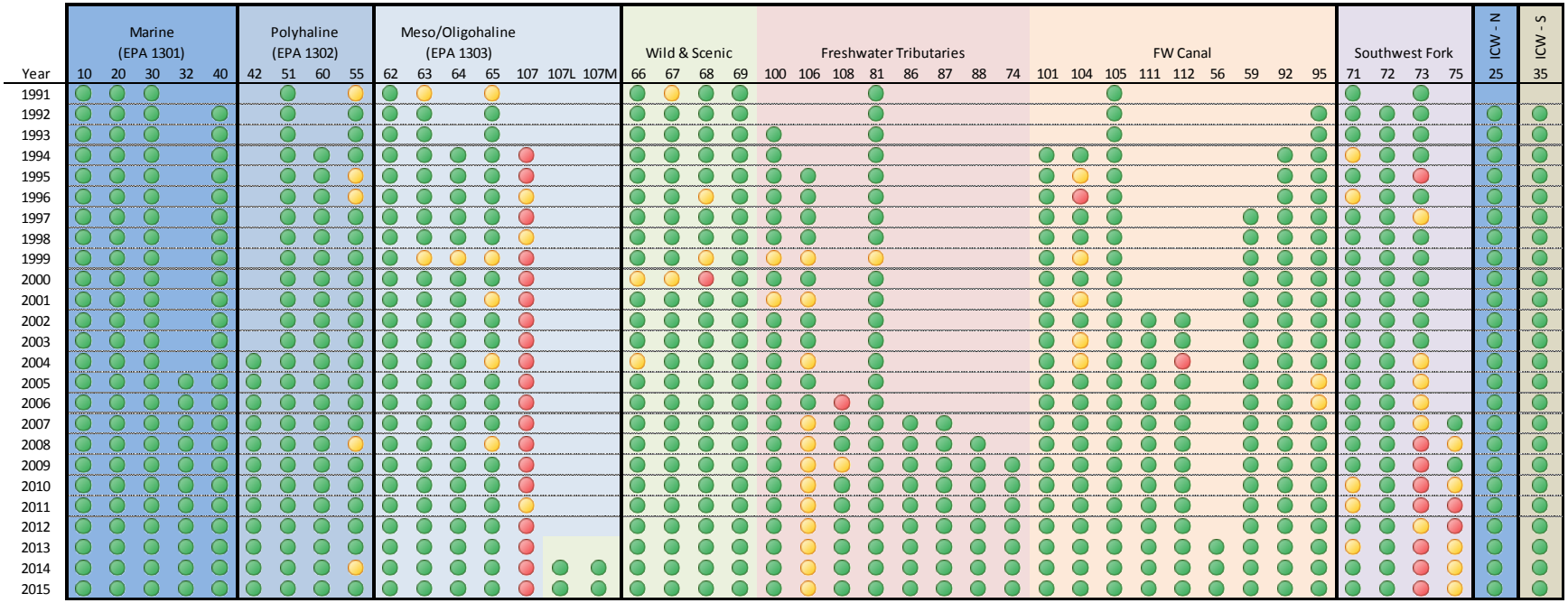
# Chlorophyll *a*

Annual Geometric Mean; Data through 8/2015



# Fecal Coliform Bacteria

Annual Geometric Mean




DEP Standard 200-399 cfu/100 ml: Yellow; >400 cfu/100 ml: Red

# Appendix D

Water quality sample count and cost summary for
RiverKeeper Water Quality Monitoring Project (SO788) for
LRPI reporting period of July 1, 2014-June 30, 2015

| Sample Group | Description | Cost per Sample: | Total # of Samples funded by DEP Funds | Total for Group (DEP Funds only) | Total # Samples Collected & Analyzed | Total Cost | LRD Share |
|---|---|---|---|---|---|---|---|
| **A** | **Temperature** | $2.00 | 235 | **$470.00** | 635 | $1,270.00 | $800.00 |
| **B** | **Salinity; Secchi Depth; Depth** | $5.00 | 700 | **$3,500.00** | 955 | $4,775.00 | $1,275.00 |
| **C** | **Turbidity; Conductivity; pH** | $5.80 | 720 | **$4,176.00** | 1651 | $9,575.80 | $5,399.80 |
| **D** | **Total Suspended Solids** | $7.90 | 170 | **$1,343.00** | 381 | $3,009.90 | $1,666.90 |
| **E** | **Alkalinity** | $9.45 | 170 | **$1,606.50** | 381 | $3,600.45 | $1,993.95 |
| **F** | **PAR** | $10.00 | 75 | **$750.00** | 288 | $2,880.00 | $2,130.00 |
| **G** | **Color** | $12.00 | 169 | **$2,028.00** | 381 | $4,572.00 | $2,544.00 |
| **H** | **Ammonia, Nitrite/Nitrate, Ortho-phosphate** | $13.65 | 510 | **$6,961.50** | 1143 | $15,601.95 | $8,640.45 |
| **I** | **Fecal coliform; Total Phosphorus, TKN** | $21.00 | 510 | **$10,710.00** | 1149 | $24,129.00 | $13,419.00 |
| **J** | **Total Organic Carbon** | $25.00 | 125 | **$3,125.00** | 257 | $6,425.00 | $3,300.00 |
| **K** | **Enterococci** | $26.25 | 60 | **$1,575.00** | 157 | $4,121.25 | $2,546.25 |
| **L** | **Cholorophyll-a** | $31.50 | 170 | **$5,355.00** | 371 | $11,686.50 | $6,331.50 |
| **M** | **Sucralose - Freshwater** | $300.00 | 12 | **$3,600.00** | 33 | $9,900.00 | $6,300.00 |
| **N** | **Sucralose - Saltwater** | $400.00 | 12 | **$4,800.00** | 19 | $7,600.00 | $2,800.00 |
| **Total DEP Funds** | | | **3638** | **$50,000.00** | 7801 | $ 109,146.85 | $ 59,146.85 |