Appendix 2-3: Annual Permit Report for the Biscayne Bay Coastal Wetlands Project

Permit Report (May 1, 2014–April 30, 2015)
Permit Number: 0271729

Bahram Charkhian

Contributors: Dallas Hazelton[1],Craig Grossenbacher[2], Josh Mahoney[2], Jennifer Possley[3], Lucia Baldwin, Ben Gu, and Leslye Waugh

SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in Attachment A lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

[1] Miami-Dade County, Natural Areas Management, Parks, Recreation, and Open Spaces Department
[2] Miami-Dade County, Department of Regulatory and Economic Resources, Environmental Resources Management, Restoration and Enhancement Section
[3] Fairchild Tropical Botanic Garden

Table 1. Key permit-related information.

Project Name:	Biscayne Bay Coastal Wetlands Project
Permit Number:	0271729-007
Issue and Expiration Dates: 0271729-006 (renewal): 0271729-007 (modification):	 Issued: 4/18/2013; Expires: 4/18/2018 Issued: 7/18/2014
Project Phase:	Operations
Permit Specific Condition Requiring Annual Report:	28
Reporting Period:	May 1, 2014–April 30, 2015
Report Lead:	Bahram Charkhian bcharkh@sfwmd.gov 561-682-2284
Permit Coordinator:	Leslye Waugh lwaugh@sfwmd.gov 561-682-6483

Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality Data
C	Hydrologic Data
D	Summary of Water Quality at BB53, MI01, MW01, and PR01 during WY2015 and Comparisons with Class III Standards for Marine Waters
E	Summary of Water Quality at S-700 Pump Station during WY2015 and Comparisons with Class III Freshwater Criteria
F	Total Monthly Flow, Nitrite + Nitrate, Ammonia, Total Kjeldahl Nitrogen, Total Nitrogen, Total Organic Nitrogen, and Total Phosphorus Loads and Flow-weighted Mean Concentrations at S-700
G	Monthly Discharges through BBCW L-31E Culverts during WY2015
H	Monthly Water Levels Upstream, Downstream, and 100 Meters Downstream of S-23A and S-23D

PROJECT STATUS

During Water Year 2015 (WY2015) (May 1, 2014–April 30, 2015), routine compliance monitoring was conducted for water quality and ecological parameters. Short-term hydrologic improvements continued to be realized, as described in the section *Conclusions Regarding Project Success*, and in various other sections of this report. Miami-Dade County, Biscayne Bay National Park, Deering Estate Park, and the Deering Estate Foundation contributed to project efforts.

To improve the benefits of the Deering Estate Flow-way component, construction of a one-acre expansion of Biscayne Bay Coastal Wetlands Deering Estate Charles Deering Education Wetlands was initiated by Miami-Dade County in collaboration with the South Florida Water Management District (SFWMD or District), and is expected to be completed in May 2015.

During the WY2015 dry season, from October 15, 2014, through April 15, 2015, the District conducted the L-31 East (L-31E) Pilot Pump Test. The test was originally planned for three months of operation, but favorable water conditions allowed the test to be extended to six months. The goals and objectives of the pilot test were to divert available water released as a point source to Biscayne Bay via water control structure S-20F from the South Dade Conveyance System into the L-31E canal reach between the Military and C-103 canals, and then, when opportunity exists, to promote redistribution of water flow through the L-31E Culverts into remnant tidal creeks, improving nearshore salinity regimes. Additionally, information gathered during the test is to be used to verify the proper location and sizing for the permanent pump station (S-709) authorized in the federal project. The test diverted over 3,300 acre-feet (ac-ft) of water to L-31E Culverts wetlands. Some of the results of the pump test are described within this annual report. Full details of the pump test are to be documented in an assessment final summary report planned to be submitted to FDEP in July 2015.

CONCLUSIONS REGARDING PROJECT SUCCESS

Based on Biscayne Bay Coastal Wetlands (BBCW) project data collected during the last four years of ecological monitoring and a comparison of this to baseline data, the project is trending towards success. The quality of all water redirected from canals to wetlands via the L-31E Culverts and the Deering Estate Flow-way improved prior to entering Biscayne Bay. Additionally, point source discharges from the C-100 and C-103 canals have been significantly reduced, possibly improving salinity conditions in the nearshore area of Biscayne Bay. Monitoring results demonstrate a clear improvement of hydrologic conditions in response to Deering Estate Pump Station (S-700) operation.

For the L-31E Culverts, from December 2012 through WY2015, approximately 20,186 acre-feet have been diverted into the freshwater and saltwater wetlands east of the L-31E canal. Based on field observations and ecological monitoring data collected during WY2015, the percent cover of category I and II invasive exotic plants within the vicinity of the L-31E Culverts has been reduced to less than five percent, which is the target. Overall, existing vegetation along the two 100-meter (m) transects located downstream of Culverts S-23A and S-23D appeared to be in better condition than in previous years. The previously documented and persistent whitefly (Aleyrodidae) and sooty mold (Ascomycota) within the scrub red mangrove (*Rhizophora mangle*) wetlands located downstream of Culvert S-23D have vanished, and the mangroves appeared to have more and healthier foliage. During both semi-annual monitoring events this year, periphyton was found ubiquitously encasing the submerged portions of the mangrove prop roots (salinity concentration was less than 5 at the time). Sawgrass expansion has been observed within the project boundary east and west of the L-31E canal. The District completed mapping sawgrass within 470 acres of Miami Dade-County preserve wetlands in February 2015 and there was an increase in sawgrass acreage assessed by mapping from 43.07 acres (2013) to 48.02 (2015).

L-31E Pilot Pump Test ecological monitoring results show that all water redirected to coastal wetlands from the C-100 and C-103 canals during the test helped restore more natural sheetflow within the L-31E Culverts wetlands. Pumping for the test maintained the L-31E canal stage at an optimal level of approximately 2.2 feet National Geodetic Vertical Datum of 1929 (NGVD29).

For the Deering Estate Flow-way, wetland stage and inundation have increased in the Cutler Creek/Slough during the reporting period. Distribution of available water has been improved by the Deering Estate Flow-way. Since December 2012, over 36,886 ac-ft of available water has been diverted from the C-100 canal via the Deering Estate Flow-way. With S-700 pumping at 100 cubic feet per second (cfs), inundation of the wetlands is at 95 percent of the target, and the hydrologic connection between upstream surface water and coastal wetlands has been restored. Vegetation within the vicinity of the Deering Estate Flow-way responded to changed hydrology, including the die-off of upland vegetation, the emergence of wetland species, and the expansion of sawgrass. During the reporting period, salinity in Cutler Creek, North Creek, and nearshore at the mouth of Cutler Creek was reduced in both groundwater and surface water.

These results demonstrate that the BBCW project is achieving success and short-term hydrologic improvements are being realized.

PROBLEMS ENCOUNTERED

Delivering adequate fresh water to wetlands east of the L-31E canal through the L-31E culverts has been a continuous challenge for the District due to the unavailability of sufficient water for the project to operate as designed.

ACTIONS TO ADDRESS PROBLEMS

To increase the available freshwater within the L-31E Culverts, the District conducted a Pilot Pump Test, as described in the Project Status section above. Based on ecological data collected, the pump test was successful, the freshwater project performance target for WY2015 was met, and short-term hydrologic improvements are being realized in response to the test.

In WY2016, the District will apply for a permit modification to allow the pilot pump test to continue for up to five years, again using a temporary 40-cfs pump. The goals and objectives of the test would remain the same as for the initial pump test, and will also help to determine the size and location of a permanent pump station (S-709).

INTRODUCTION

PROJECT OVERVIEW

The BBCW project was designed to address issues with nearshore hypersalinity and coastal wetlands degradation by restoring more natural patterns of freshwater delivery into Biscayne Bay. By rehydrating coastal wetlands and reducing wasteful point source freshwater discharges, the project will improve nearshore substrate and fish habitats, now stressed by high salinities in the dry season, and reduce excessive freshwater outflow during the rainy season. The project will accomplish these goals by redirecting fresh water that is currently discharged directly and rapidly to the bay through man-made canals to spreaders in coastal wetlands adjacent to the bay that are currently bypassed by the canals. This will help restore freshwater and saltwater wetlands, reestablish more natural salinity concentrations, and provide a more productive nearshore nursery habitat.

Implementation of the BBCW Phase 1 Project began under SFWMD's Acceler8 Program in cooperation with the United States Army Corps of Engineers' (USACE's) project delivery team.

USACE and the District worked side by side to coordinate the ongoing planning efforts of the project delivery team during the design phase of the project components by the District. As a project partnership agreement for the BBCW Phase 1 Project has not yet been executed, any construction efforts initiated by the District are identified in the pre-partnership credit agreement, dated August 13, 2009.

Project Purpose and Benefits

The BBCW Phase 1 Project, as defined in the Comprehensive Everglades Restoration Plan (CERP), is a multipurpose project that provides for ecosystem restoration of freshwater wetlands, tidal wetlands, nearshore habitat, and rehydrating and reconnecting freshwater wetlands to marine wetlands. As stated in the project implementation report, project objectives include capturing freshwater runoff from the watershed into Biscayne Bay (USACE and SFWMD 2012). This freshwater runoff will be treated and redistributed to moderate point source canal discharges to do the following:

- Improve freshwater and estuarine habitat.
- Improve salinity distribution and reestablish productive nursery habitat along the shoreline.
- Restore the quantity, quality, timing and distribution of fresh water to Biscayne Bay and Biscayne National Park
- Preserve and restore the spatial extent of natural coastal glades habitat within the BBCW Project's study area.

The BBCW Phase 1 Project will maintain the current level of flood protection within the drainage basin.

Project Description

The BBCW Phase 1 project is the first CERP project constructed with direct benefit to Biscayne National Park and Biscayne Bay in Miami Dade County. Due to the important benefits of this project, and because the SFWMD has secured most of the land required for construction and implementation of the project, the SFWMD moved forward with expedited design and construction prior to congressional authorization of Phase 1. The project encompasses a footprint of approximately 3,761 acres and includes three components: Deering Estate, Cutler Wetlands, and L-31E Flow-way (**Figure 1**).

The project is essential to achieving restoration of tidal wetlands and nearshore habitats within Biscayne Bay, including Biscayne National Park. Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permit 0271729, issued by FDEP to the District, authorized the District to construct and operate the L-31E Culverts and Deering Estate Flow-way.

This report satisfies Specific Condition 28 of the permit, which requires the District to submit an annual report to FDEP detailing the progress of the BBCW Project, and to incorporate it into the *South Florida Environmental Report*.

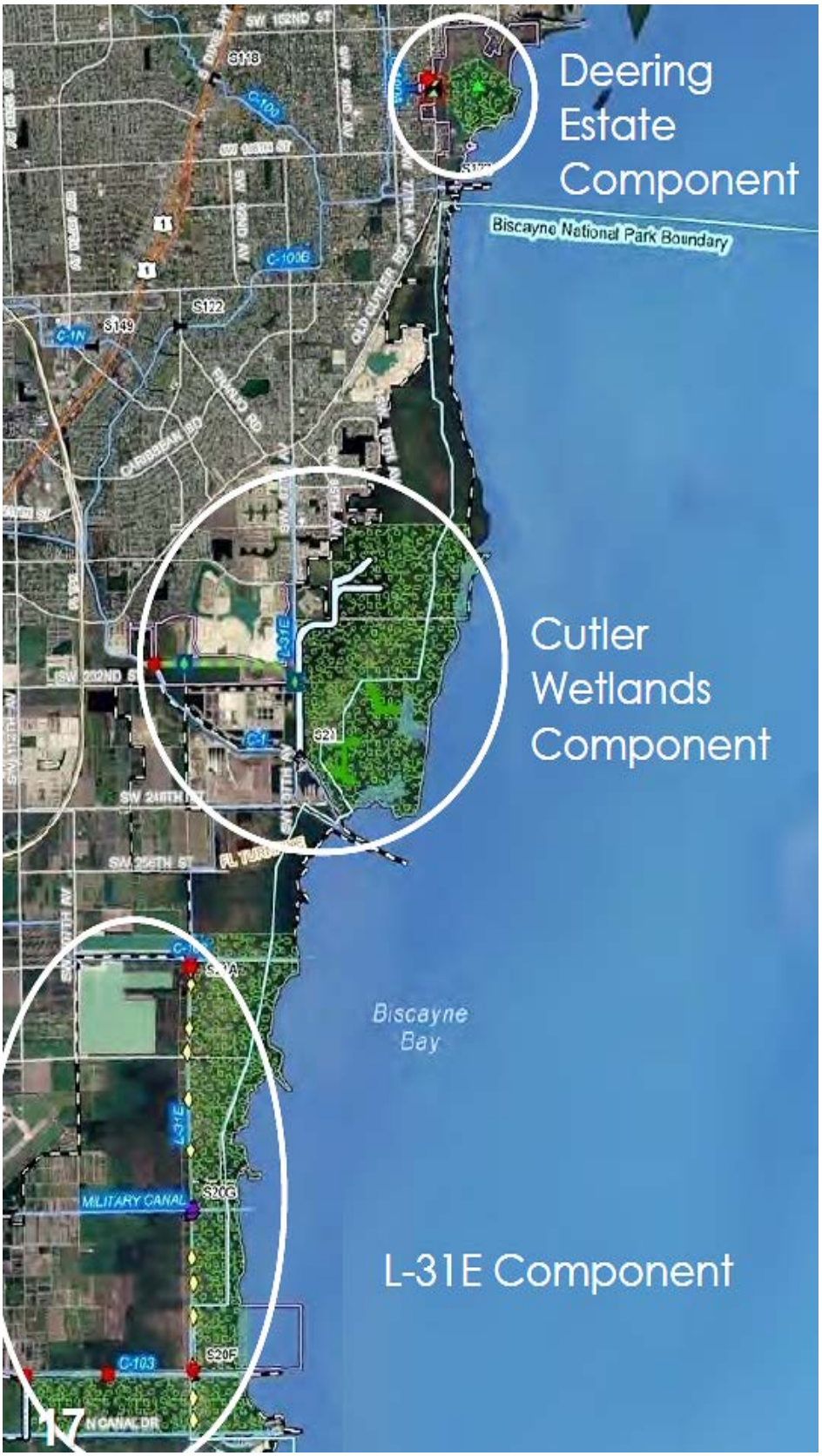


Figure 1. BBCW project components.

L-31E CULVERTS

The L-31E Culverts component is located in Miami-Dade County between the C-102 and C-103 canals (Sections 4, 9, 28, 33, and Township 56 South Range 40 East and Township 57 South Range 40 East). The component's goal is to reestablish, at least in part, historical sheetflow and wetland hydroperiods downstream of the project area. This component may also provide the additional benefit of mitigating impacts of discharging fresh water via the existing canals. The component is expected to achieve its objectives by redirecting flow that was historically discharged through structures S-21A, S-20F, and S-20G. This flow is now discharged into the coastal wetlands east of the L-31E levee, along Biscayne Bay, via four flap-gated culverts: S-23A, S-23B, S-23C, and S-23D (**Figure 2**). Construction of the culverts began on January 11, 2010, and was completed on June 10, 2010. The baseline monitoring event was conducted in August 2010, and was followed by monthly monitoring events. Annual mitigation monitoring has taken place since WY2012.

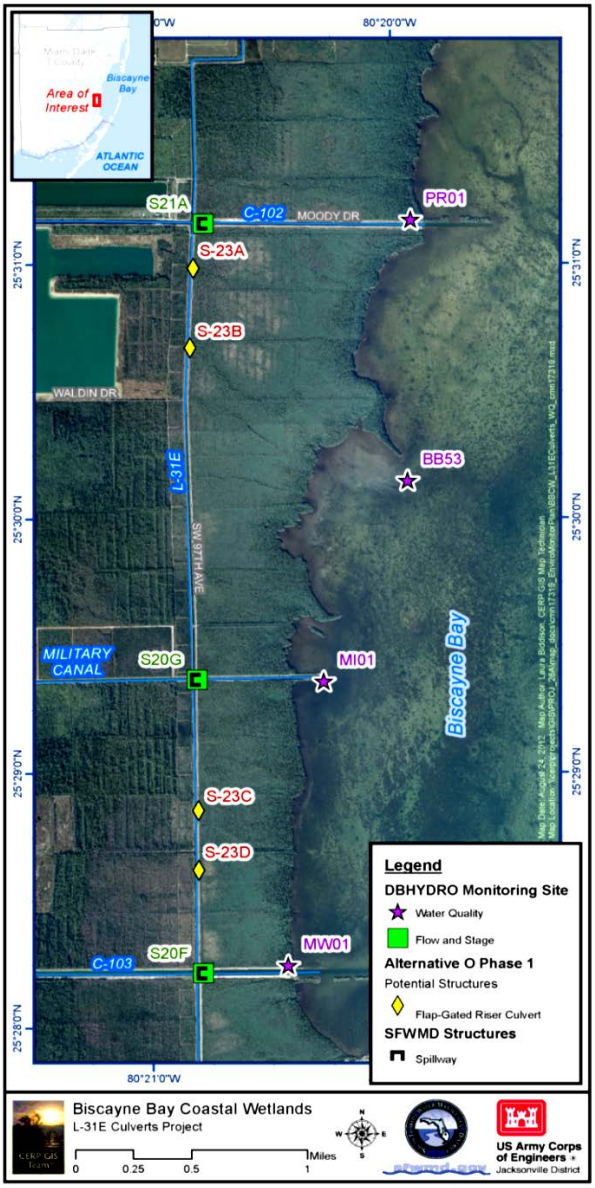


Figure 2. L-31E Culverts component features and associated monitoring sites.

DEERING ESTATE FLOW-WAY

The Deering Estate Flow-way component is located in southeastern Miami-Dade County at 1580 Old Cutler Road, Palmetto Bay, Florida (**Figure 3**). This component included construction of a 500-foot extension of a spur canal off the C-100A canal, a 100-cfs pump station with associated discharge piping, and an outlet spreader structure. Excluding the spreader structure, these components were constructed on a 9.7-acre tract referred to as the "Powers Addition Parcel", located west of, and adjacent to, the Deering Estate.

The Deering Estate Flow-way will redirect up to 100 cfs of water from the C-100A canal system, through the C-100A spur canal into the Cutler Drain on the component site, and within the Deering Estate Flow-way, thus restoring a portion of the historic freshwater flow through the flow-way and into Biscayne Bay (**Figure 3**). Final project completion of the S-700 pump station (**Figure 4**) was in March 2012, initial operational testing began in April 2012, water quality monitoring started in May 2012, and routine operation began in December 2012.

Miami-Dade County and the District are cooperating on this component with the following goals and projected benefits:

- Redirect up to 100 cfs of the existing point source discharge from the S-123 structure by optimizing the capture and conveyance of fresh water from the C-100A spur canal to the coastal wetlands in the immediate vicinity of the Cutler Drain, east of Old Cutler Road, which will result in a small reduction in the point source discharges at S-123. The redirection of water shall consider how the rate of withdrawal will affect future water availability for the S-700 pump station, water supply, and the maintenance of canal stage for saltwater intrusion prevention
- Rehydration of the wetland region east of Old Cutler Road, and restoration of a more natural freshwater flow regime
- Establishment of an educational wetland on the Powers Addition Parcel

CUTLER WETLANDS FLOW-WAY

The proposed Cutler Wetlands Flow-way (**Figure 1**) will consist of a pump station on the C-1 canal, a lined conveyance canal, a spreader canal system, box culverts under roadways, and plugging of mosquito control ditches. The pump station will deliver water to the spreader canal located in the saltwater wetlands via a lined conveyance canal. The proposed Cutler Wetlands Flow-way is currently under permit review with regulatory agencies.

Figure 3. Deering Estate Flow-way component features.

Figure 4. Deering Estate Flow-way Pump Station (S-700).

PERMIT HISTORY

The original CERPRA permit and all modifications issued to the District are as follows:

- 0271729-001, issued September 10, 2007, with an expiration date of September 10, 2012, was the original permit for the L-31E Culverts.
- 0271729-002, issued May 23, 2008, with an expiration date of May 23, 2013, was a permit modification that included the Deering Estate Flow-Way component of the BBCW Project.
- 0271729-003, issued January 11, 2007, was an exemption for a geotechnical survey for the Cutler Flow-way.
- 0271729-005, issued June 8, 2012, modified the water quality monitoring requirements for the Deering Estate Flow-Way and included a number of minor changes to the permit language.
- On August 9, 2013, FDEP approved a revised water quality monitoring plan eliminating pesticides and other toxicants monitoring in surface water and fish tissue.
- 0271729-006, issued April 18, 2013, with an expiration date of April 18, 2018, renewed the permit for five years.
- 0271729-007, issued July 18, 2014, with an expiration date of April 18, 2018, was a permit modification for the L-31E Pilot Pump Test.

WATER QUALITY MONITORING SUMMARY

Water quality monitoring has been conducted for the BBCW project from the baseline (October 2009–June 2010) through WY2015 for permit required parameters. During the baseline, water quality measurements were taken to characterize the state of the system prior to increasing the discharge of fresh water into Biscayne Bay. This section summarizes results of these monitoring activities and includes a basic statistical summary of the data and comparison with applicable Class III water criteria (62-302.530, Florida Administrative Code) (Attachment D, **Tables D-1**, **D-2**, and Attachment E), a comparison of annual means and medians (Attachment D, **Tables D-3** and **D-4**), an assessment of water quality trends (**Figures 5-10**), and total monthly flow and flow weighted mean concentrations (FWMCs) for some parameters at S-700 (**Figures 11-14** and Attachment F). All monitoring activities were performed in accordance with Chapter 62-160, F.A.C., and the water quality monitoring plan associated with the permit. Water quality data for WY2015 are provided in Attachment B.

STATISTICAL METHODOLOGY

A basic statistical summary of the data was performed for each parameter (Attachment D, **Tables D-1** to **D-2**, and Attachment E). Results presented include mean, standard deviation, minimum, 25th percentile (q25), median, 75th percentile (q75), maximum, the number of samples below the detection limit, the number of excursions, and the percent excursions.

To assess trends in water quality, an analysis of variance (ANOVA) was used to compare the mean parameter concentrations for each water year, and the Kruskal-Wallis Test was performed to compare median parameter concentrations for each water year. Most of the time the two approaches yielded similar results, however, where they differ, preference should be given to the Kruskal-Wallis Test results. If the p-value for a comparison is less than or equal to the significance level of 0.05, there is a statistically significant difference between the mean or median concentration for the years.

For a visual assessment of trends at the L-31E Culverts component, annual means and medians by water year were graphed (**Figures 5-7**). For the Deering Estate Flow-way, box plot comparisons of water quality parameters monitored at S-700 for WY2013–WY2015 were plotted (**Figures 8-10**).

L-31E CULVERTS

During WY2015, monthly water quality monitoring was conducted for the L-31E Culverts (stations BB53, MI01, MW01, and PR01) (**Figure 2**) for in situ (field measured) parameters and grab samples. Grab samples were collected at 0.5 m water depth and analyzed in the laboratory. In situ measurements were taken as described below.

Through September 30, 2014, monitoring was conducted by the Miami-Dade Department of Environment Resources Management, in accordance with FDEP FT 1000 Standard Operating Procedure (“General Field Testing and Measurement”) (FDEP 2014), and the Miami-Dade County DERM Quality Manual (Miami-Dade DERM 2010). During this time, in situ parameters were measured at three different depths: at the surface (about 0.1 m); at an intermediate depth of 0.5 m for tidal stations and 1 m for non-tidal stations; and at 0.1 m above the bottom (total) depth of each site. When total water depth was less than 0.5 m, and monitoring site access was possible, sampling events were limited to surface and bottom measurements. Monitoring at different depths for each site is not a requirement of the permit, but was conducted in an effort to consider water stratification in Biscayne Bay. In this report, surface measurements are designated as "surface", bottom measurements as "bottom", and the depth in between as "middle".

Since October 1, 2014, monitoring has been conducted by the District, in accordance with the SFWMD Field Sampling Quality Manual (SFWMD 2015), with measurements taken only at a single depth (0.5 m) for each site. If total depth was less than 1 m, monitoring was conducted at half the total depth.

Attachment D, **Table D-1**, summarizes in situ parameters for WY2015. Attachment D, **Table D-2**, summarizes laboratory analyzed water quality parameters by station during WY2015. There were no exceedances of Class III marine water criteria for the monitored parameters during WY2015. **Table D-3** provides a comparison of in situ parameters by water year from the baseline period through WY2015. An evaluation of trends is presented in **Figures 5-7**.

Among in situ parameters, means and medians of dissolved oxygen (DO) did not seem to vary much from year to year. DO values measured at BB53 were consistently higher than at any other stations, especially at the surface and middle water depths. For pH, a statistically significant difference between years was observed at the surface and middle depth at station MI01 (**Table D-3**). pH values appeared highest during WY2012 (**Figure 6**). For surface salinity and specific conductance, statistically significant differences between years occurred at sites MW01 and PR01. Statistically significant differences between years also occurred at sites MI01, MW01, and PR01 for bottom salinity and specific conductance. There do not appear to be any long-term annual trends for in situ parameters measured for the project.

Among laboratory analyzed parameters, there was a decrease in water color and total suspended solids (TSS) at all stations during WY2015. For other laboratory analyzed parameters, there were statistically significant differences between water years, however the graphs in **Figures 5-7** do not show any apparent trends. Nitrate + nitrite (NO_x) values had statistically significant differences between years at MW01 (**Table D-4**), but there does not appear to be a trend (**Figure 7**). NO_x levels at PR01 were higher than at any other station for the entire period of record. Statistically significant differences between years were observed for total Kjeldahl nitrogen (TKN) at MW01, with the largest values occurring in WY2015. There were also significant differences between years for total phosphorus (TP) values at sites BB53, MW01, and PR01, with the highest values observed in WY2015. Although the differences between years for TKN and TP for some sites were statistically significant, these differences were very close to the method detection limits (MDL). There does not appear to be a trend in the annual means for TKN and TP. For turbidity, statistically significant differences between years occurred at sites MI01 and MW01. The highest turbidity values at both sites were observed in WY2015, but there does not appear to be a trend in the annual means.

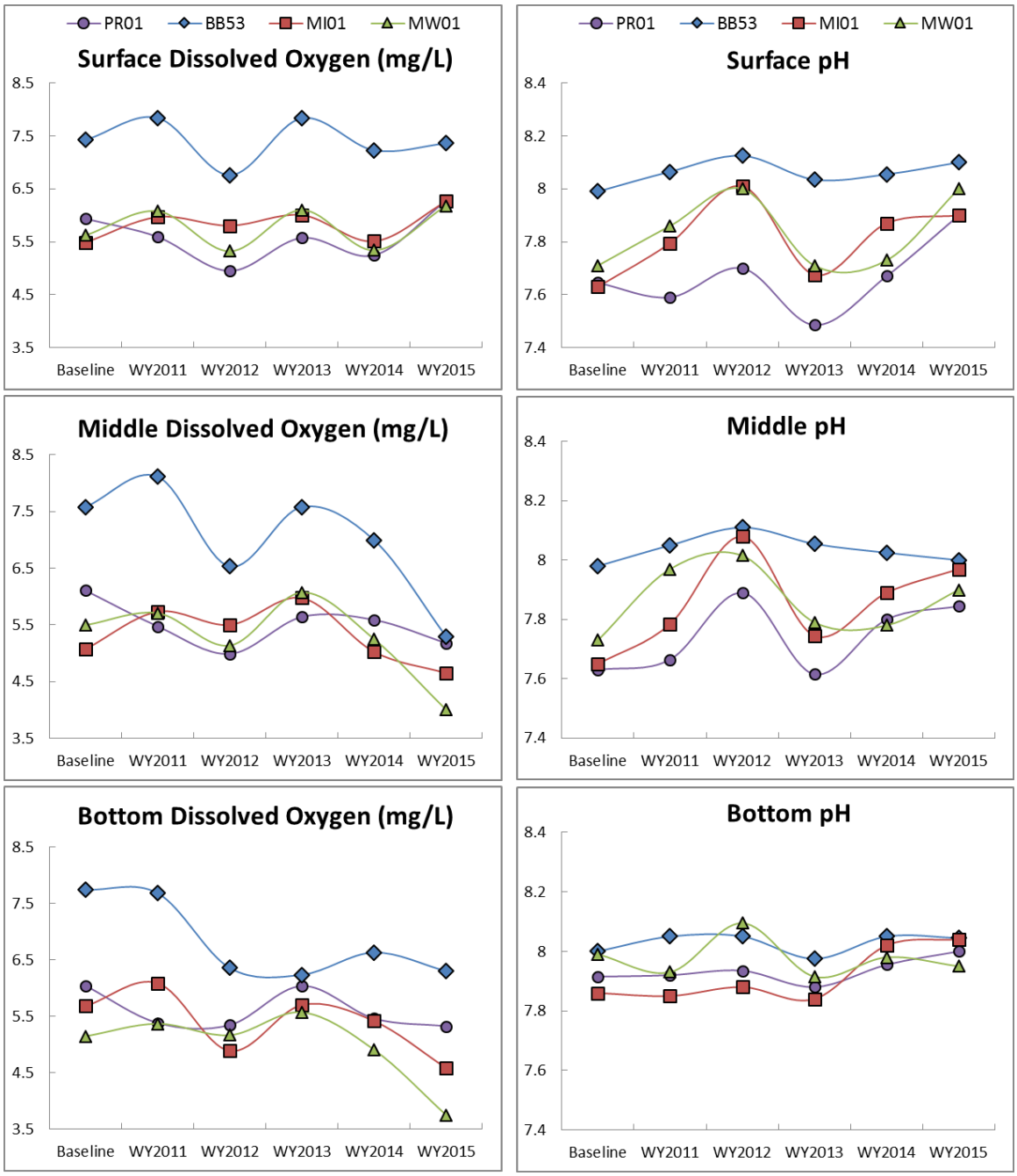


Figure 5. Annual mean concentration of DO and annual median pH at stations BB53, MI01, MW01, and PR01 (Baseline: October 7, 2009–June 9, 2010).

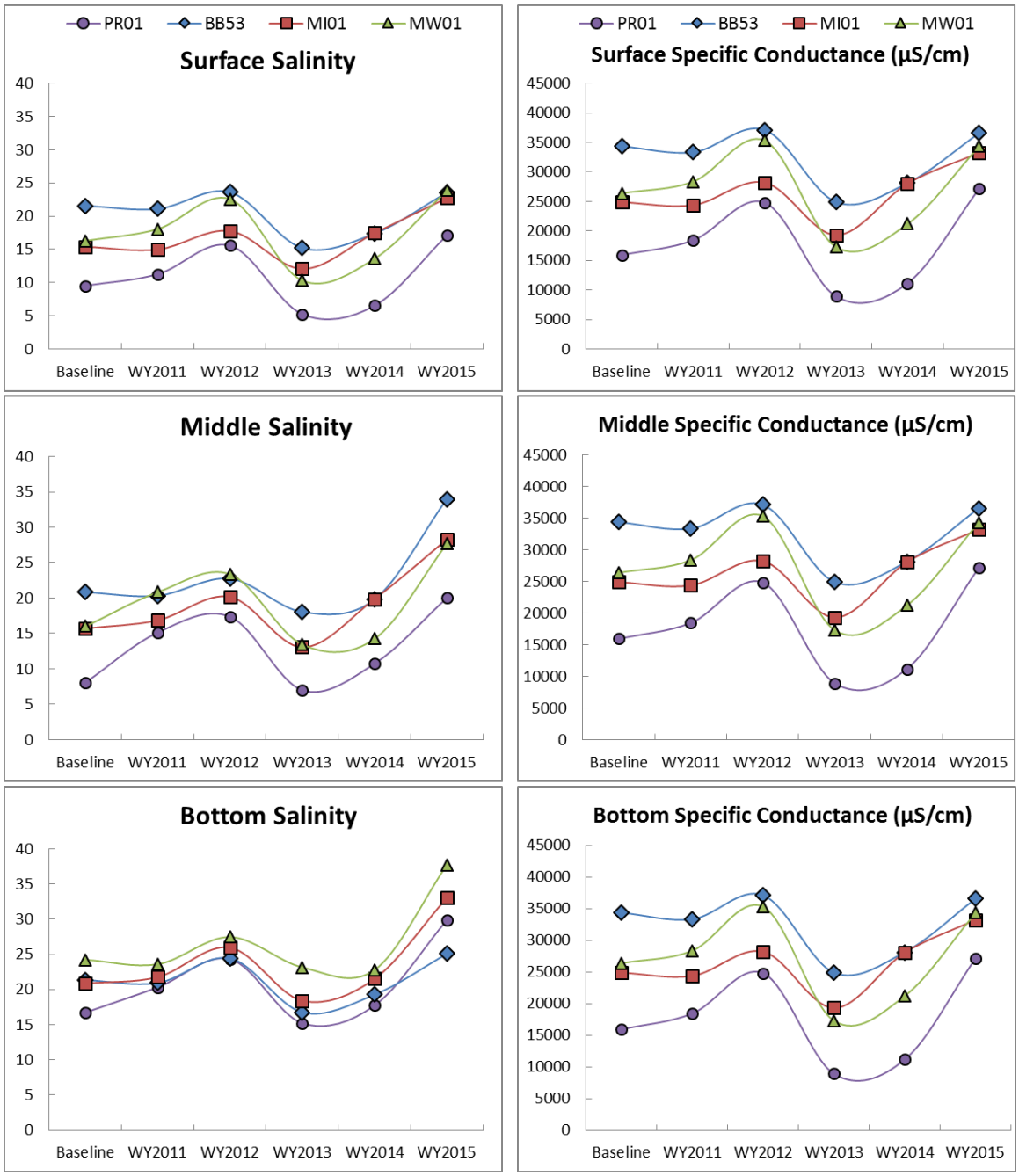


Figure 6. Annual mean salinity and annual mean specific conductance in microsiemens per centimeter (µS/cm) at stations BB53, MI01, MW01, and PR01 (Baseline: October 7, 2009–June 9, 2010).

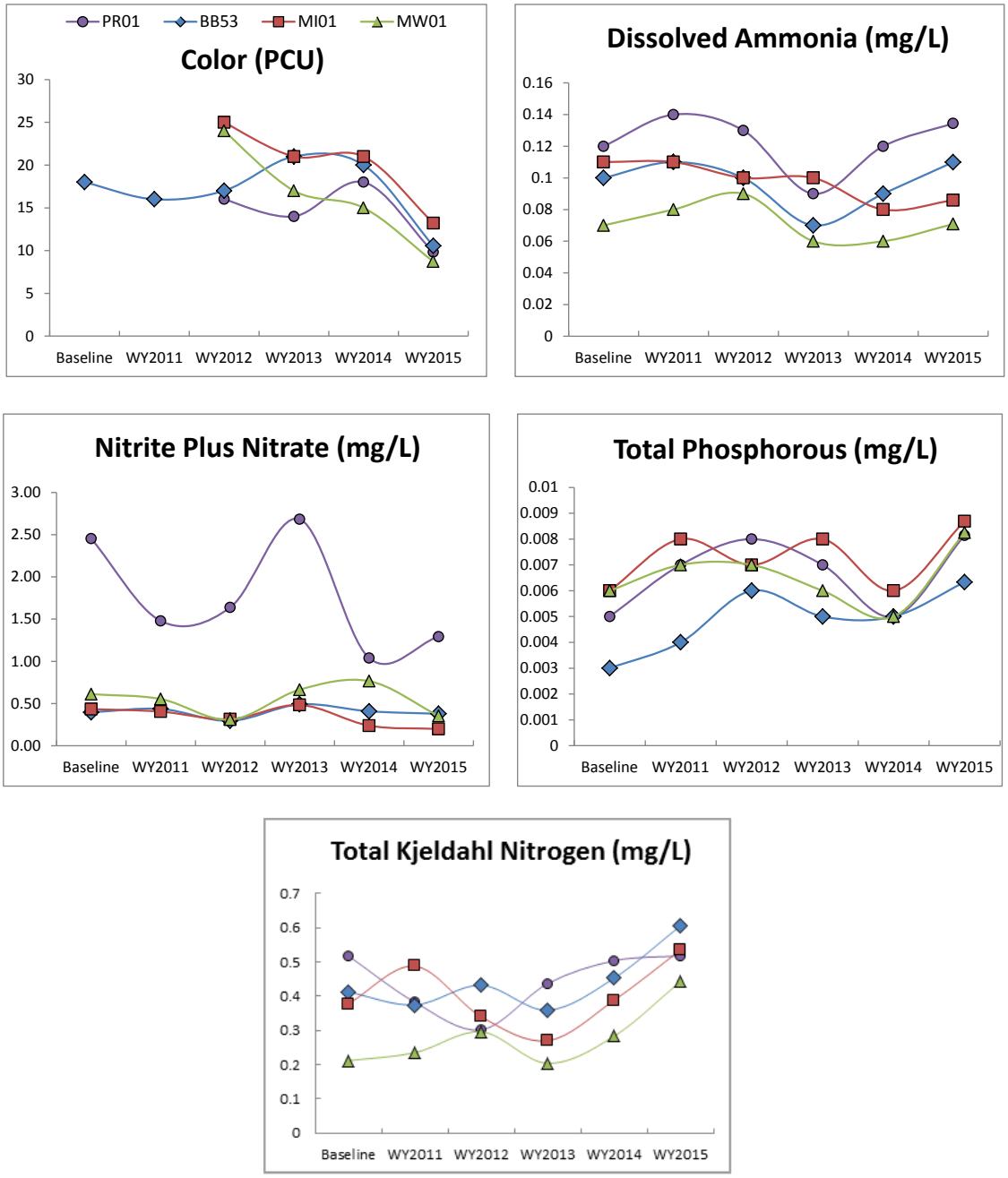


Figure 7. Annual mean concentration of laboratory analyzed parameters at stations BB53, MI01, MW01, and PR01 (Baseline: October 7, 2009–June 9, 2010). [Note: PCU – photo conductor units.]

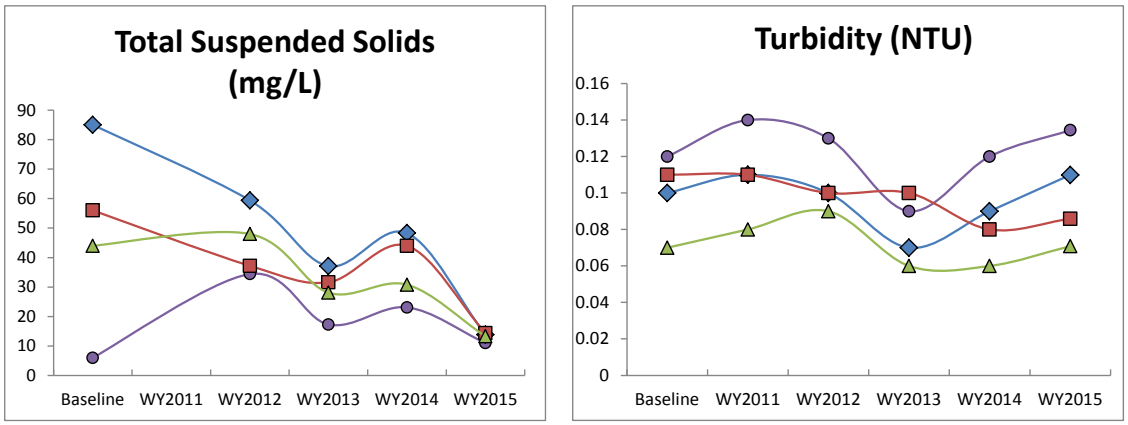


Figure 7. Continued. [Note: NTU – nephelometric turbidity units.]

DEERING ESTATE FLOW-WAY

Since December 2012, water quality samples have been collected at the S-700 pump station to evaluate the condition of the Deering Estate Flow-way (**Figure 3**). A summary of WY2015 water quality and comparisons with Class III freshwater criteria (62-302.530, Florida Administrative Code) is provided in Attachment E. There were no exceedances of Class III freshwater criteria for the monitored parameters during WY2015 (Attachment E).

A trend analysis was not conducted for the Deering Estate Flow-way component because of the limited period of record. However, box plot comparisons of water quality parameters monitored for the component are shown in **Figures 8**, **9**, and **10**, and statistical comparisons of annual means and medians is provided in **Table 3**.

The box plots of in situ parameters presented in **Figure 9** show a small decrease in annual median DO and percent DO saturation values, however, there was not a statistically significant difference between years (**Table 3**). Annual means of specific conductance have decreased since WY2013 (**Figure 9** and **Table 3**), however annual medians were not statistically different.

Among laboratory analyzed parameters, there were statistically significant differences in annual means and medians of dissolved ammonia and TKN (**Table 3**), however the differences were small, in the range of the practical quantification limit (PQL). Dissolved ammonia has a PQL of 0.01 milligrams per liter (mg/L) and its annual medians differed by 0.01 mg/L. TKN has a PQL of 0.1 mg/L and its annual medians varied by 0.1 mg/L. Dissolved ammonia had the same means and medians for WY2014 and WY2015, while TKN had the smallest mean and median in WY2014.

To assess whether there are trends in the data, total monthly flow, total monthly loads, and FWMC for total nitrogen (TN) and TP at S-700 for the period of record were calculated and graphed as time series plots (**Figures 11-14**). Flow data collection began in late November 2012, and the availability of nutrient data makes load calculation possible starting in December 2012 (Attachment F).

Generally higher TP and TN loads were observed during the wet season (May–October), when flows were at their highest. Conversely, TP and TN FWMC were higher during the dry seasons (November–April) when flows are typically lower. Loads and FWMC for TN were higher in WY2013 than in WY2014 and WY2015. However, these patterns were not observed for TP loads or FWMC. The highest TP FWMC for the period of record occurred during the WY2014 dry season.

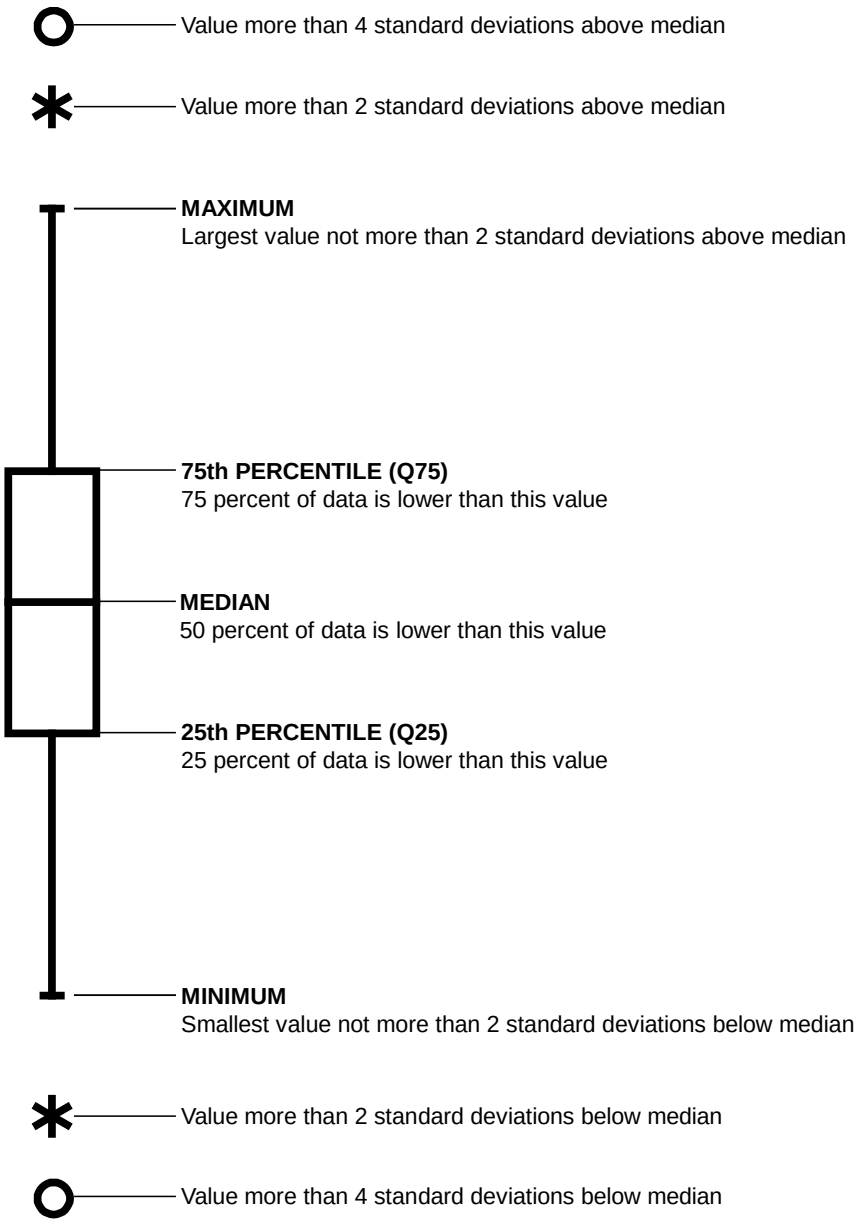


Figure 8. Description of box plots used in this report.

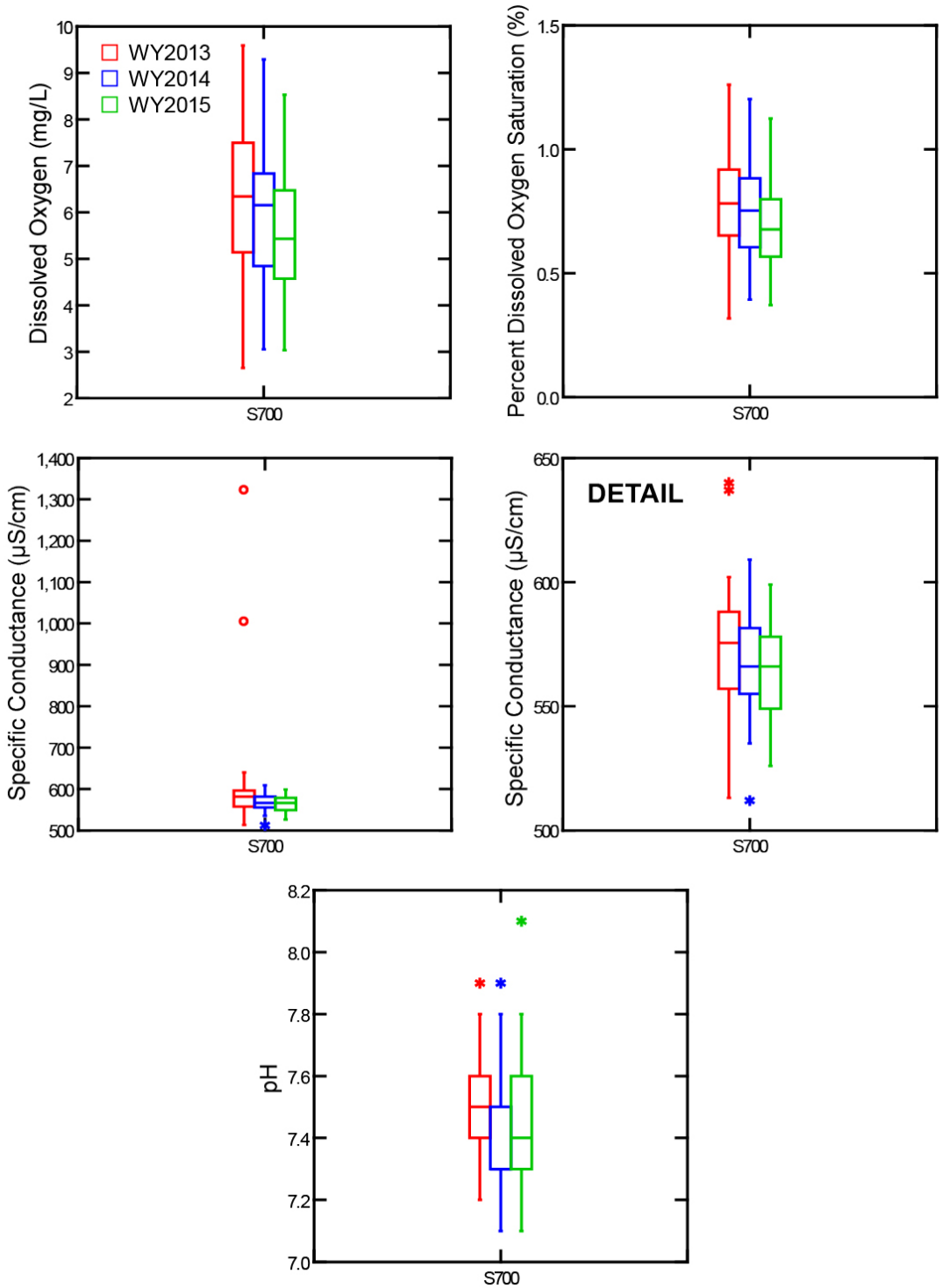


Figure 9. Box plot comparisons of various in situ (field measured) water quality parameters at S-700 pump station.
[Note: °C – degrees Celsius and µS/cm – microsiemens per centimeter. A description of box plots is provided in **Figure 8**.]

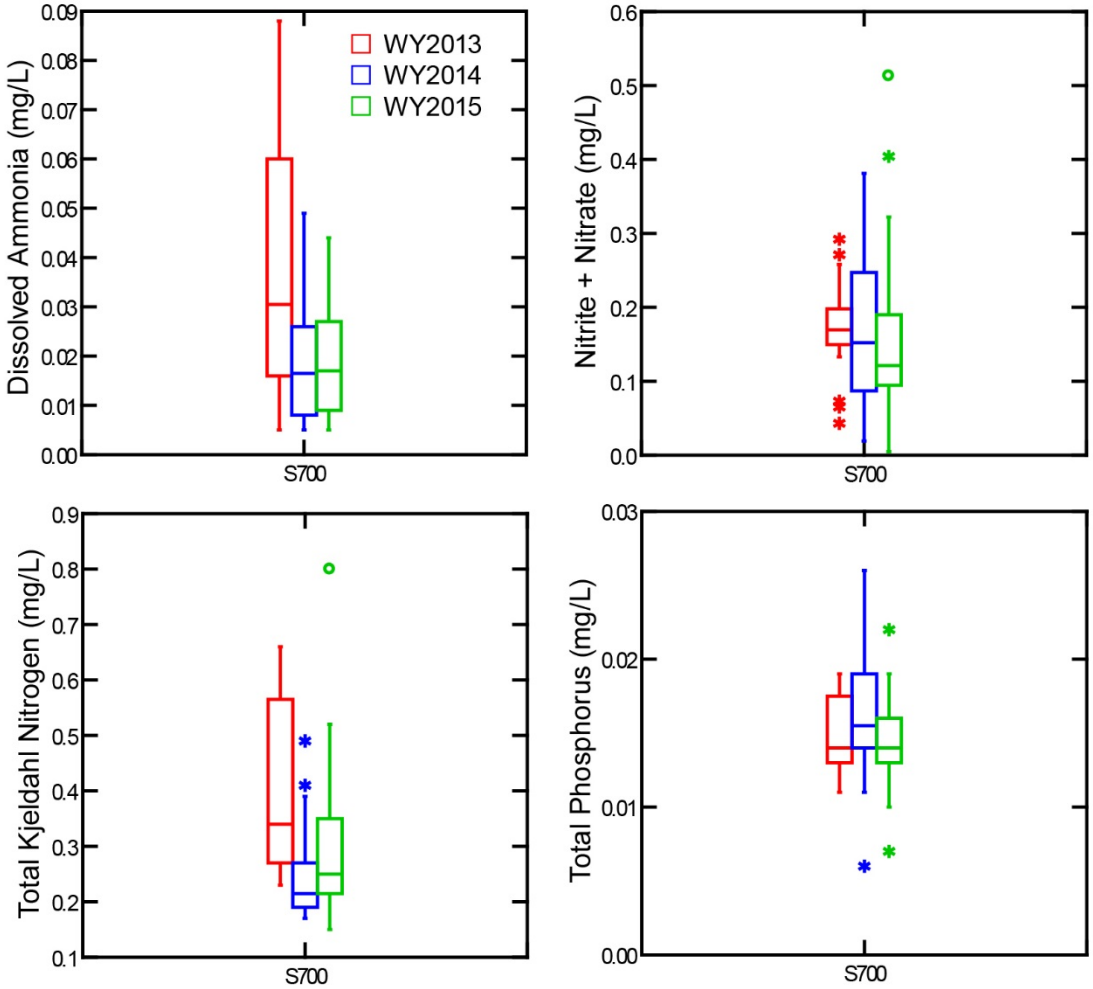


Figure 10. Box plot comparison of various laboratory analyzed water quality parameters at S-700 pump station. [Note: A description of box plots is provided in **Figure 8**.]

Table 3. S-700 water quality parameter means and medians by water year. [Note: p-values below or equal to 0.05 are shown in red, bold, underlined font.]

Parameter	Period	Number of Measurements	Arithmetic Mean	Median
IN SITU (FIELD MEASURED) PARAMETERS				
Dissolved Oxygen (mg/L)	WY2013	20	6.3	6.3
	WY2014	27	5.9	6.2
	WY2015	23	5.5	5.43
	ANOVA and Kruskal Wallis p-Value		0.354	0.292
Percent Dissolved Oxygen Saturation	WY2013	20	NA	0.78
	WY2014	26	NA	0.75
	WY2015	23	NA	0.68
	Kruskal Wallis p-Value		NA	0.431
pH	WY2013	20	NA	7.5
	WY2014	26	NA	7.3
	WY2015	23	NA	7.4
	Kruskal Wallis p-Value		NA	0.062
Specific Conductance (µS/cm)	WY2013	20	634	582
	WY2014	27	567	566
	WY2015	23	564	566
	ANOVA and Kruskal Wallis p-Value		**0.048**	0.159
Water Temperature (°C)	WY2013	20	25.8	25.2
	WY2014	27	27.2	27.5
	WY2015	23	26.8	28.2
	ANOVA and Kruskal Wallis p-Value		0.131	0.239
LABORATORY ANALYZED PARAMETERS				
Dissolved Ammonia (mg/L)	WY2013	18	0.04	0.03
	WY2014	26	0.02	0.02
	WY2015	21	0.02	0.02
	ANOVA and Kruskal Wallis p-Value		**0.001**	**0.048**
Nitrite + Nitrate (mg/L)	WY2013	20	0.173	0.17
	WY2014	25	0.172	0.152
	WY2015	23	0.161	0.121
	ANOVA and Kruskal Wallis p-Value		0.910	0.517
Total Kjeldahl Nitrogen (mg/L)	WY2013	20	0.4	0.3
	WY2014	26	0.2	0.2
	WY2015	23	0.3	0.3
	ANOVA and Kruskal Wallis p-Value		**< 0.001**	**< 0.001**
Total Phosphorus (mg/L)	WY2013	20	0.015	0.014
	WY2014	26	0.016	0.016
	WY2015	19	0.014	0.014
	ANOVA and Kruskal Wallis p-Value		0.188	0.244

Key to Units: °C – degrees Celsius; µS/cm – microsiemens per centimeter; and mg/L – milligrams per liter.

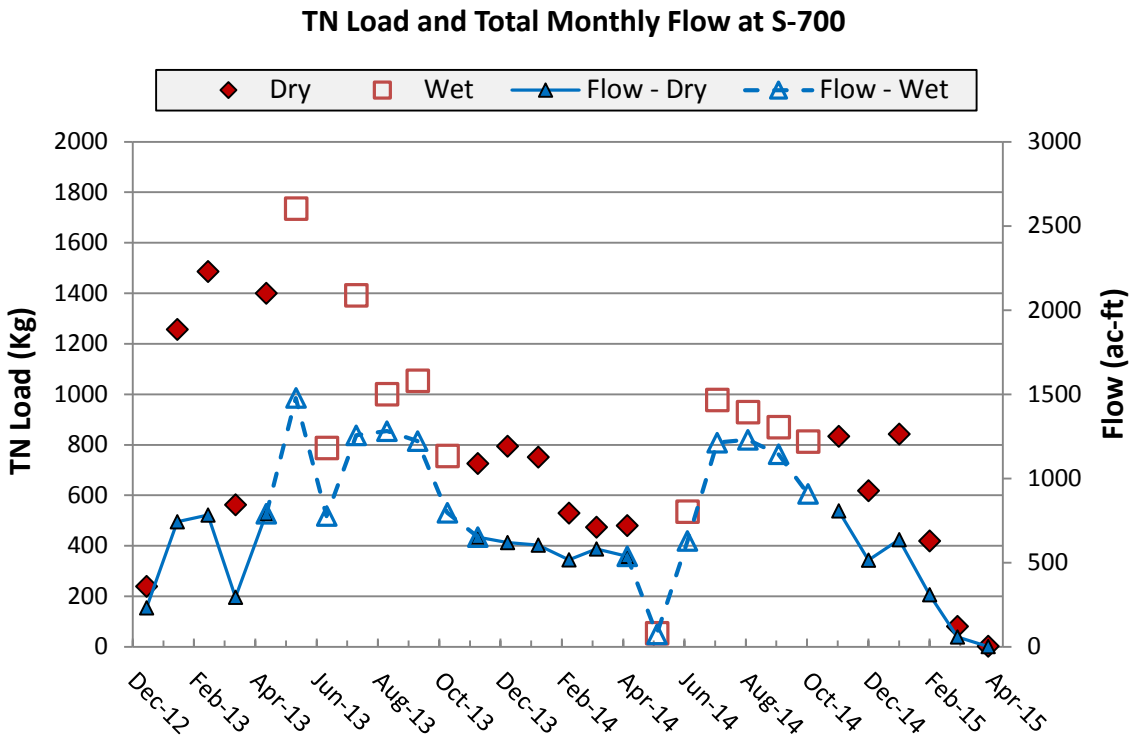


Figure 11. S-700 TN load in kilograms (Kg) and total monthly flow in acre-feet (ac-ft).

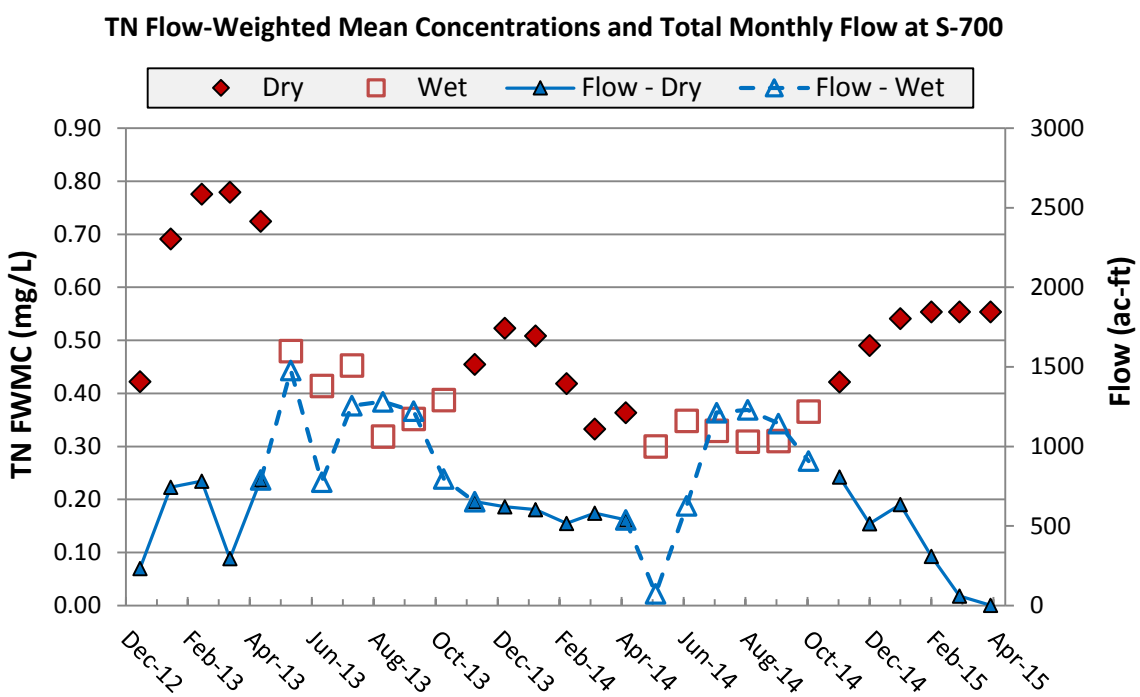


Figure 12. S-700 TN FWMC in mg/L and total monthly flow in acre-feet (ac-ft).

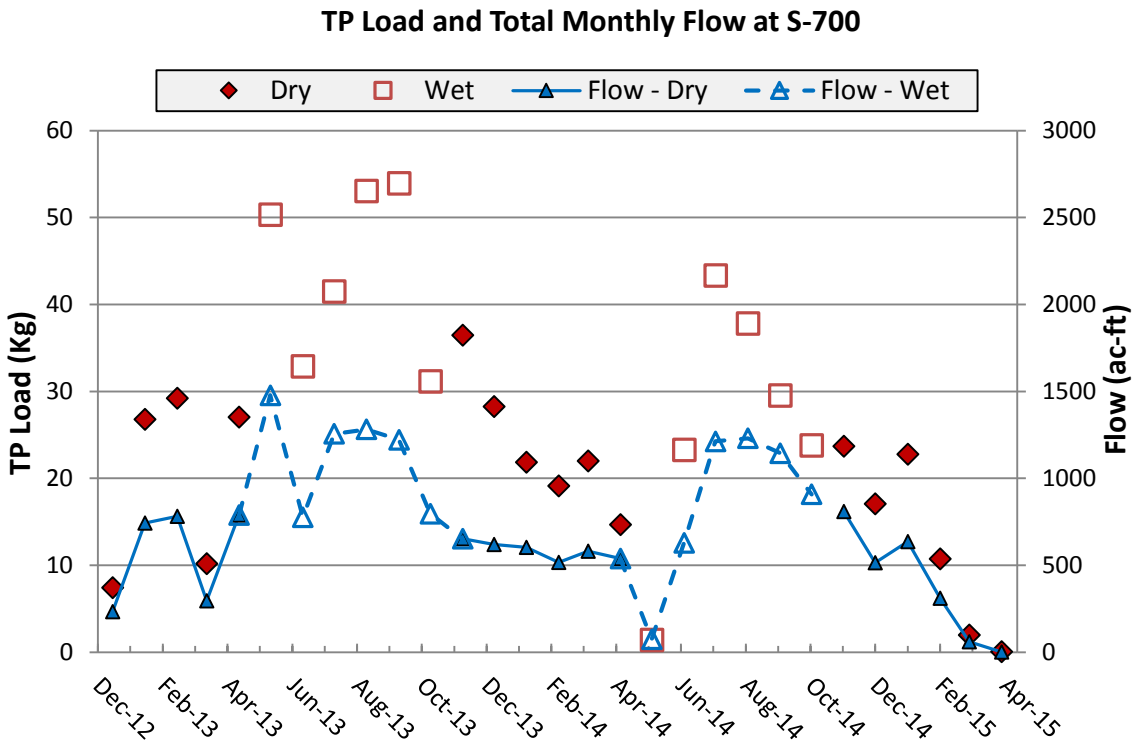


Figure 13. S-700 TP load in kilograms (Kg) and total monthly flow in acre-feet (ac-ft).

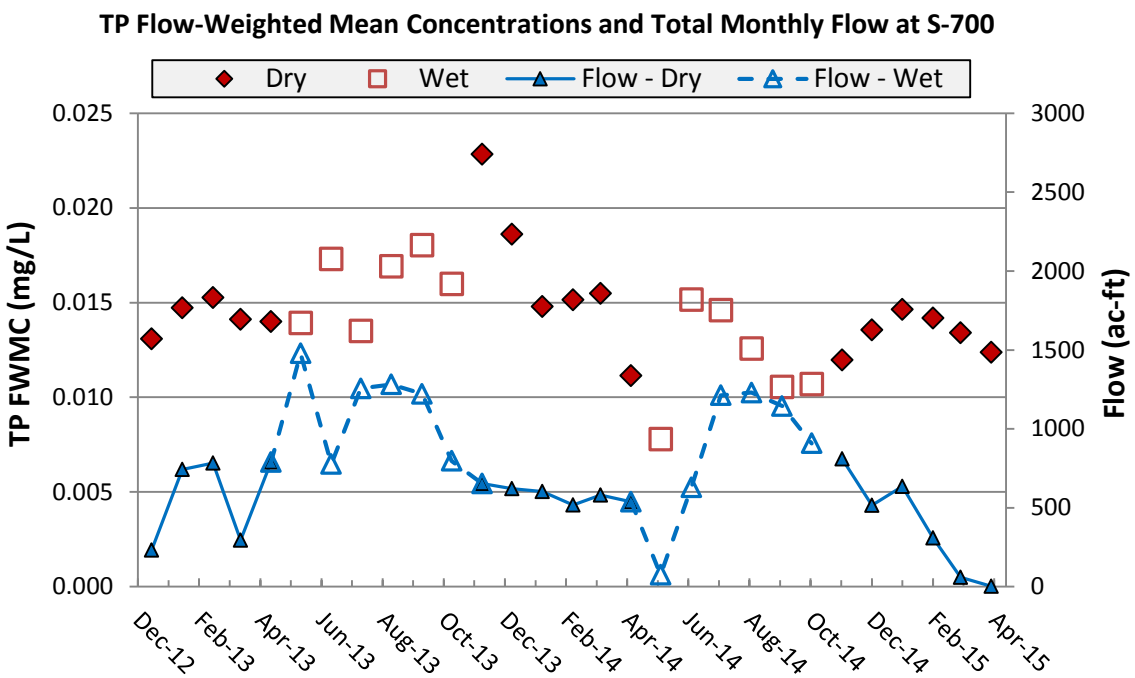


Figure 14. S-700 TP FWMC in mg/L and total monthly flow in acre-feet (ac-ft).

MERCURY MONITORING

In accordance with permit requirements, the District conducted mercury monitoring and evaluation for the BBCW project. During WY2015, mercury monitoring for the BBCW Project was in Phase 2 - Tier 1 Three-year Stabilization, which is based on A Protocol for Monitoring Mercury and Other Toxicants (FDEP and SFWMD 2011). Under this phase, surface water samples for total mercury (THg), methylmercury (MeHg), and mosquitofish (*Gambusia holbrooki)* composites are collected on a quarterly basis, and samples of bluegill *(Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) are collected annually. All samples were collected at pump station S-700.

SURFACE WATER ASSESSMENT

Collection of surface water samples was attempted each quarter for THg and MeHg analysis (**Table 4**). THg concentrations ranged from 0.62 to 0.94 nanograms per liter (ng/L), with an average concentration of 0.81 ng/L. MeHg concentrations were 0.031 and 0.043 ng/L, with an average of 0.036 ng/L. The THg concentrations were well below the United States Environmental Protection Agency (USEPA) standard of 12 ng/L. There is no state or federal surface water quality standard for MeHg.

Table 4. Quarterly THg and MeHg concentrations in surface water at the BBCW Project during WY2015. All data were collected from pump station S-700.

Date	THg (ng/L)	MeHg (ng/L)
7/23/2014	0.88	0.039
10/30/2014	0.62	0.031
2/11/2015	0.81	0.043
4/15/2015	0.94	0.031
Average	0.81	0.036

FISH ASSESSMENT

THg concentrations in mosquitofish, bluegill sunfish, and largemouth bass tissues are listed in **Table 5**. During WY2015, quarterly mosquitofish composites collected at S-700 ranged from 19 to 44 nanograms per gram (ng/g), with a mean concentration of 31 ng/g. These values were well below the USEPA recommended MeHg fish tissue criterion of 77 ng/g for Trophic Level III fish. During WY2015, five bluegill sunfish and five largemouth bass were collected. The mean THg concentration for bluegill sunfish was 33 ng/g, which is also below the USEPA recommended MeHg fish tissue criterion of 77 ng/g for Trophic Level III fish. The THg value for largemouth bass was 126 ng/g. This value was also well below the THg value for Trophic Level IV fish (346 ng/g).

Table 5. THg concentrations in fish of different trophic levels collected at S-700 during WY2015.

Date	Species	THg (ng/g)	Samples
7/21/2014	Mosquitofish	43	1
10/8/2014	Mosquitofish	19	1
1/8/2015	Mosquitofish	27	1
4/2/2015	Mosquitofish	36	1
11/5/2014	Bluegill Sunfish	33	5
11/5/2014	Largemouth Bass	126	5

In summary, mercury concentrations in surface water and fish tissue samples were determined for WY2015 during the Phase 2 - Tier 1 period of the project. Surface water THg concentrations were well below the USEPA criterion. Similarly, THg concentrations in mosquitofish, bluegill, and largemouth bass were well below the USEPA recommended MeHg fish tissue criterion of 77 ng/g for Trophic Level III fish and 346 ng/g for Trophic Level IV fish, respectively.

OPERATIONS

This section discusses BBCW project operations and associated hydrologic monitoring results, including summaries of stage, flow, and rainfall. Stage and flow data are essential for gaging the success of the project toward its goals to restore the quantity, quality, timing, and distribution of fresh water to Biscayne Bay and Biscayne National Park, and to preserve and restore the spatial extent of natural coastal glades habitat within the project area. Rainfall monitoring is conducted to determine what portion of freshwater entering the system is due to atmospheric deposition rather than operational activities or other non-atmospheric sources. This is especially important in evaluating the success of the project toward its goals of improving freshwater and estuarine habitat and salinity distribution. Hydrologic data for WY2015 are provided in Attachment C.

L-31E CULVERTS

Stage and Flow at Structures

The L-31E Culverts are passive, flap-gated devices designed to divert available fresh water from the L-31E canal into adjacent wetlands. Because of their frequent stage measurements (and close proximity), daily flow rates for Culverts S-23A and S-23B were based on mean daily stages at structure S-21A, while daily flow rates for Culverts S-23C and S-23D were based on mean daily stages at structure S-20F. More specifically, the mean daily flow rates at each of the four culverts were derived by manually entering the mean daily stage at the physically closest structure (S-21A or S-20F) into the design rating curve (**Figure 15**) and identifying the corresponding flow rate.

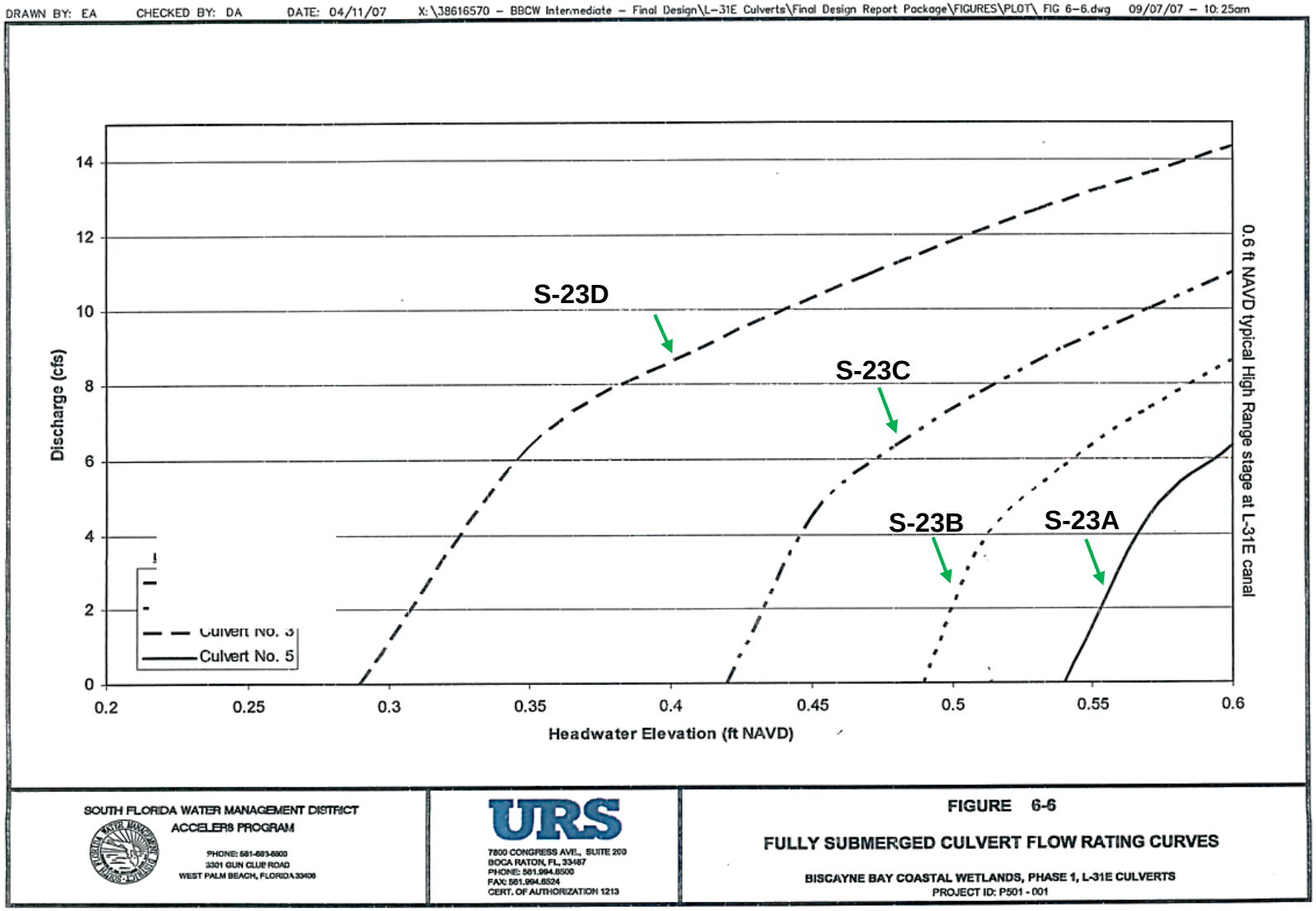


Figure 15. Fully submerged culvert flow rating curves for the L-31E Culverts. Headwater elevation from structures S-21A, S-20G, and S-20F were utilized.

Monthly mean stages for the S-20F and S-21A spillways are provided in **Table 6**. Mean monthly average flow for the L-31E Culverts (S-23A, S-23B, S-23C, and S-23D) and the S-20F and S-21A spillways are provided in Attachment G. **Figures 16** through **18** show this information in graphical form for each of the spillways. **Table 7** and Attachment G show the fresh water diverted from the L-31E canal through the L-31E Culverts to wetlands east of the L-31E levee. During WY2015, less fresh water was diverted from coastal structures S-20F and S-21A compared to previous water years (**Figures 16** and **17**). 8,243 acre-feet of fresh water was diverted as sheetflow from the C-102 and C-103 canals via the L-31E canal and L-31E Culverts to the freshwater and saltwater wetlands east of the L-31E levee and nearshore of Biscayne Bay during WY2015 (**Figure 18** and **Table 7**).

Table 6. Monthly mean stage in feet NGVD29 for the L-31E Culverts.

Date	Stage S-20F		Stage S-21A	
	Headwater (feet NGVD29)	**Tailwater** (feet NGVD29)	**Headwater** (feet NGVD29)	**Tailwater** (feet NGVD29)
May 2014	1.80	1.09	1.46	1.04
June 2014	1.94	0.83	1.66	0.78
July 2014	1.97	0.77	1.78	0.76
August 2014	2.07	1.13	1.93	1.17
September 2014	2.06	1.22	2.09	1.26
October 2014	1.64	1.40	1.59	1.38
November 2014	1.46	1.44	1.42	1.45
December 2014	1.40	1.28	1.96	1.27
January 2015	1.31	0.97	1.31	1.00
February 2015	1.31	0.98	1.29	1.01
March 2015	1.29	0.73	1.03	0.75
April 2015	1.44	0.80	1.28	0.85

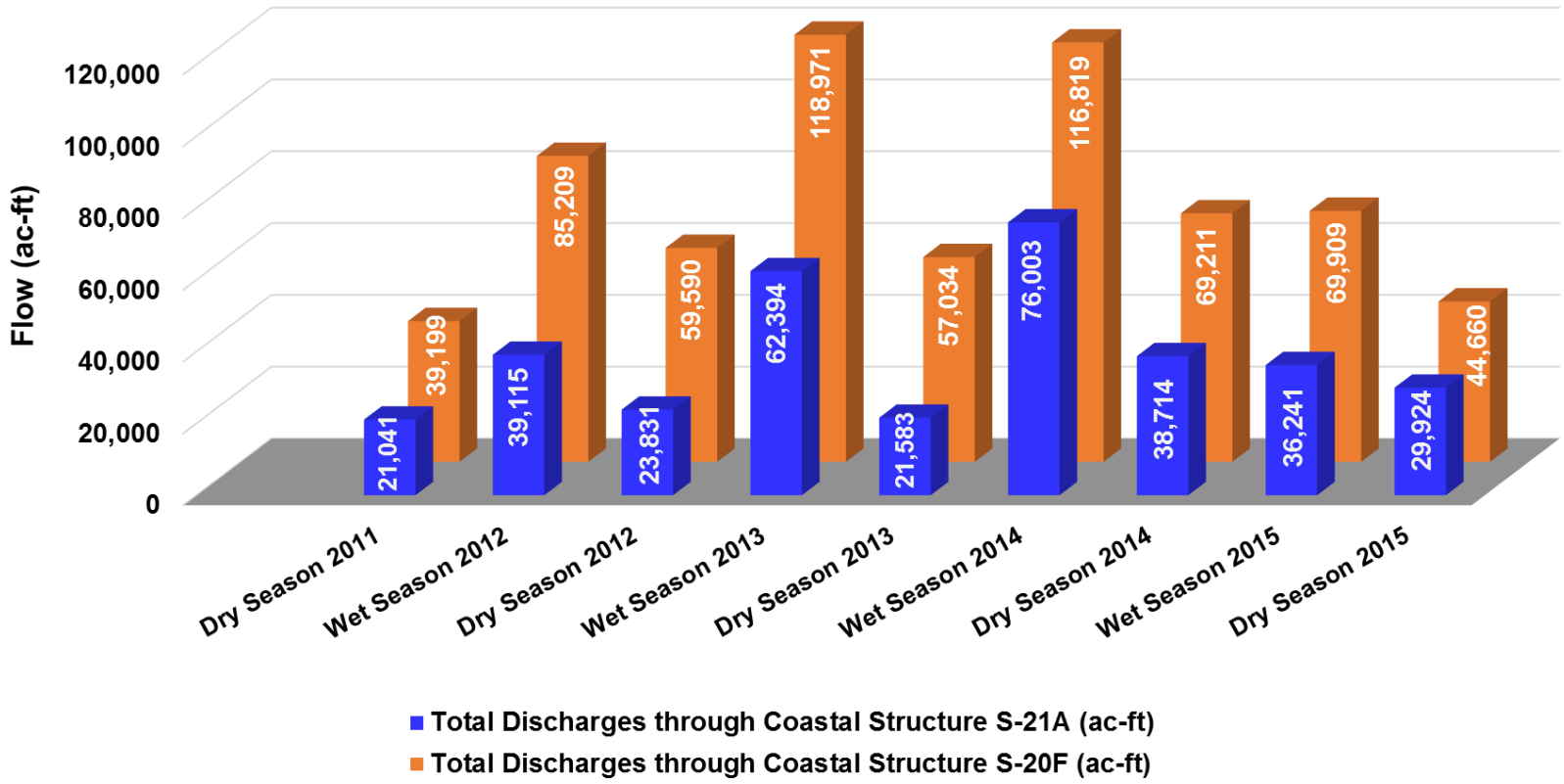


Figure 16. Comparison of total flow in acre-feet (ac-ft) through coastal structure S-21A and S-20F. [Note: Dry season is November–April and wet season is May–October.]

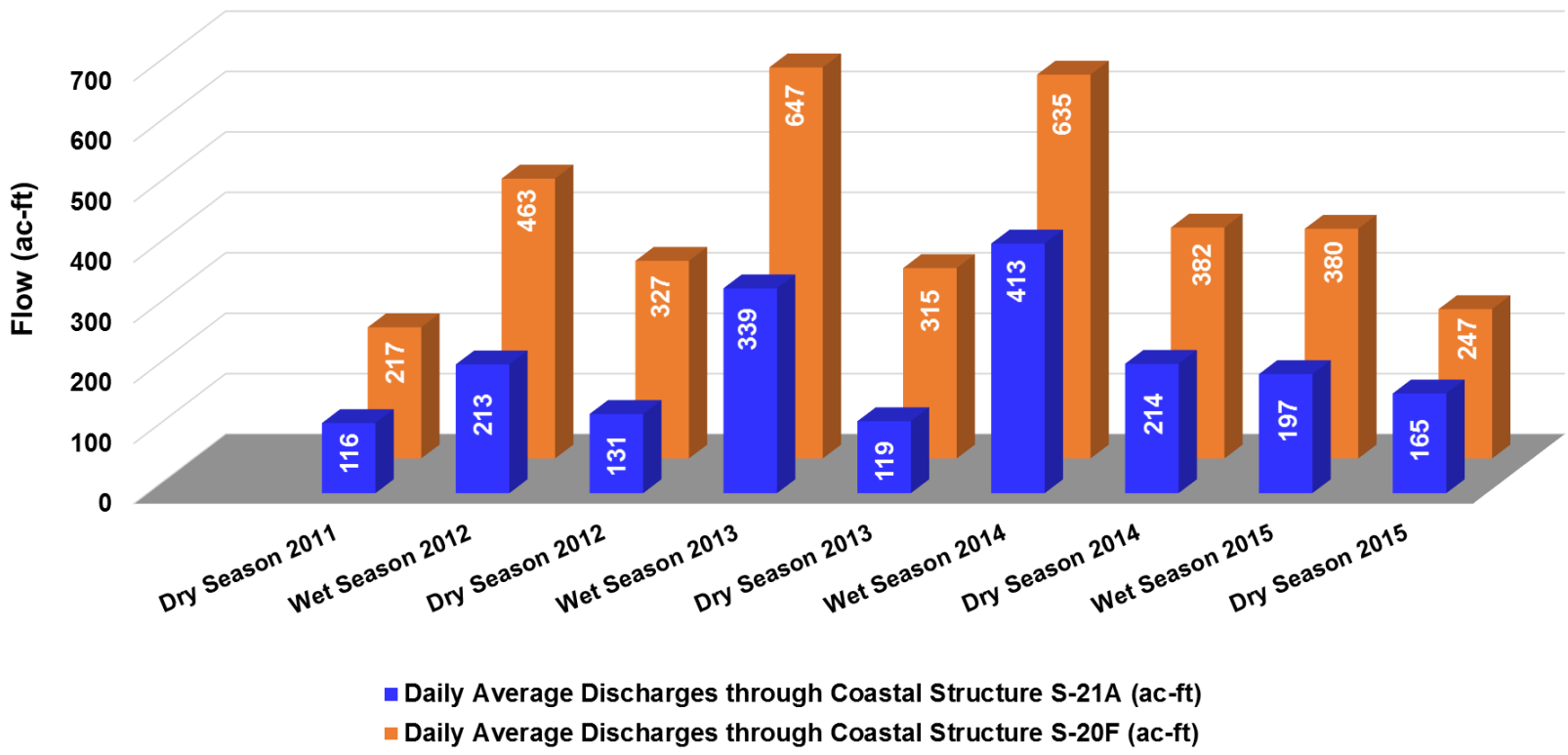


Figure 17. Comparison of daily average flow in acre-feet (ac-ft) through coastal structure S-21A and S-20F. [Note: Dry season is November–April and wet season is May–October.]

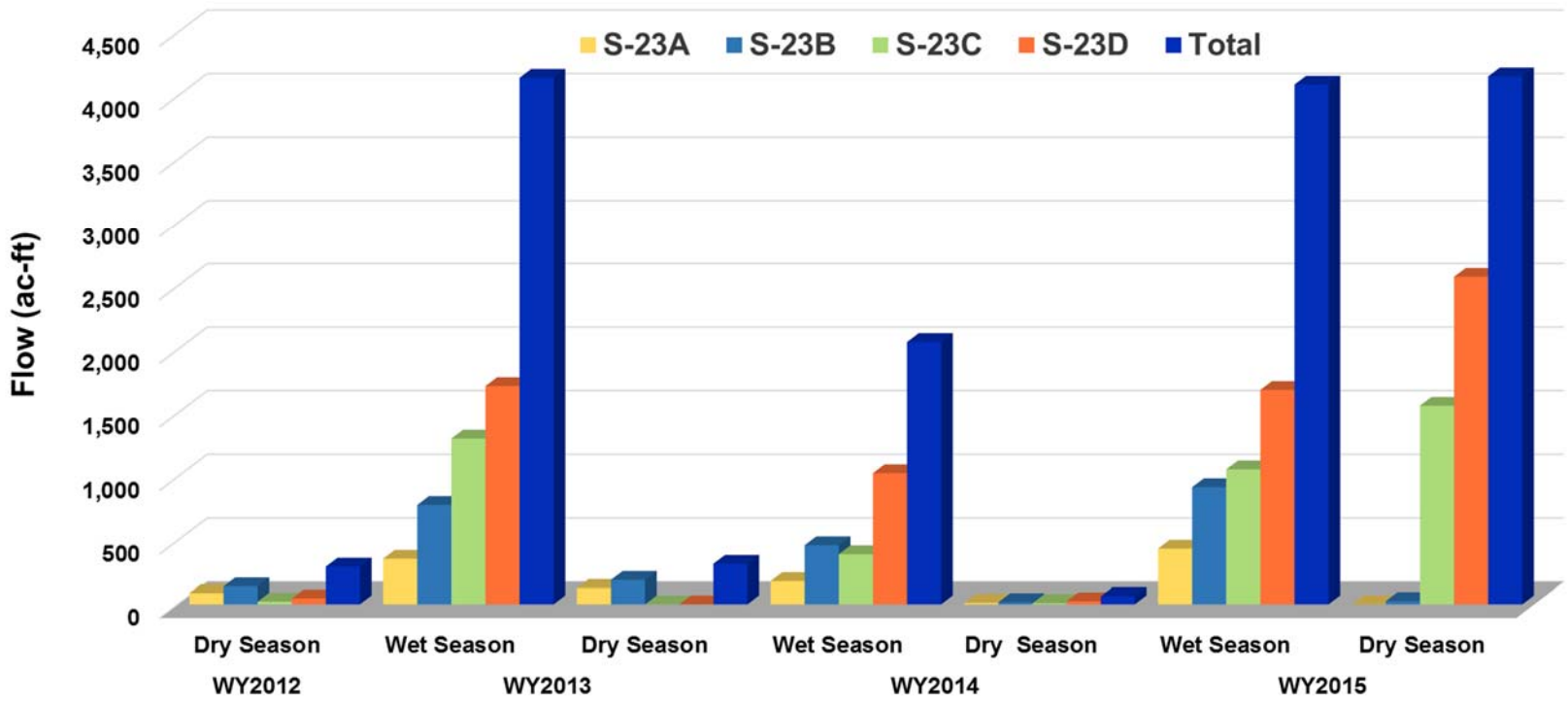


Figure 18. Comparison of freshwater flow in acre-feet (ac-ft) diverted from the L-31E canal through the L-31E Culverts to wetlands east of the L-31E levee. [Note: The majority of fresh water diverted through Culvert S-23C and S-23D during the L-31E Pilot Pump Test in the WY2015 dry season. Dry season is November–April and wet season is May–October.]

Table 7. Fresh water in acre-feet diverted from the L-31E canal through the L-31E Culverts to wetlands east of the L-31E levee.

Period	Month	L-31E Culverts Flow					L-31E Coastal Structures Flow			L-31E Culverts & Coastal Structures Total Flow	Available Water Diverted[a]	Percent Water Diverted[b]	L-31E Flow Performance Target[c]	L-31E Flow Performance Target Met?
		S-23A	S-23B	S-23C	S-23D	Total	S-20F	S-21A	Total					
WY2015 Wet Season	May 2014	0	0	0	21	21	0	0	0	21				Yes
	Jun. 2014	100	185	83	170	538	13,009	5,389	18,499	19,038	0.03	3%	4%	No
	Jul. 2014	9	98	170	320	597	24,098	10,100	34,198	34,795	0.02	2%	4%	No
	Aug. 2014	210	378	157	365	1,110	10,789	4,651	15,440	16,552	0.07	7%	4%	Yes
	Sep. 2014	114	253	523	575	1,465	7,716	7,106	14,822	16,287	0.09	9%	4%	Yes
	Oct. 2014	0	4	124	230	358	14,197	9,994	23,191	23,549	0.02	2%	4%	No
	Total	433	918	1,057	1,681	4,089	69,809	37,240	106,150	110,242				
WY2015 Dry Season	Nov. 2014	0	0	516	687	1,203	12,921	6,874	19,695	20,898	0.06	6%	4%	Yes
	Dec. 2014	0	0	517	702	1,219	10,262	6,087	16,309	17,537	0.07	7%	4%	Yes
	Jan. 2015	0	0	196	415	611	9,972	193	9,155	9,767	0.06	6%	4%	Yes
	Feb. 2015	0	0	237	467	704	6,789	533	12,102	12,806	0.05	5%	4%	Yes
	Mar. 2015	0	0	91	300	391	4,088	4,349	8,437	8,828	0.04	4%	4%	Yes
	Apr. 2015	0	26	0	0	26	1,683	1,631	3,314	3,339	0.01	1%	4%	No
	Total	0	26	1,557	2,571	4,154	45,715	19,667	69,012	73,175				
WY2015 Total		**433**	**944**	**2,614**	**4,252**	**8,243**	**115,524**	**56,907**	**175,162**	**183,417**	**0.05**	**5%**	**4%**	**Yes**

a. Available Water Diverted = Total Flow through Four L-31E Culverts / Total Flow Coastal Structures S-20F and S-21A and Four Culverts Flow

b. Percent Water Diverted = Available Water Diverted*100

c. USACE Permit Number SAJ-1994-1327 [IP-TKW) – WY2015 Dry Season: 99% of flow diverted during L-31E Pilot Pump Test through Culverts S-23C and S-23D

Water Levels Along Transects

During WY2015, water levels were lower than in previous years along the two vegetation monitoring transects, S-23A and S-23D (**Figure 27**). Water levels along the transect downstream of Culvert S-23D were higher than in previous water years, but still fell below the minimum level required for sampling (**Table 7** and Attachment H).

The average water level at wetland stage monitoring station S-23H (**Figure 19**) rose by 0.2 feet NGVD29 from 1.70 feet NGVD29 for the period before pilot pump test to 1.90 feet NGVD29 during the reporting period (**Figure 20** and **Table 7**). Slight flow was observed in the scrub red mangrove area and became undetectable past the approximately 75-meter mark. During WY2015, water levels along the transect downstream of Culvert S-23A fell below the minimum level required for sampling with lower stages than in previous water years along the transect (Attachment H).

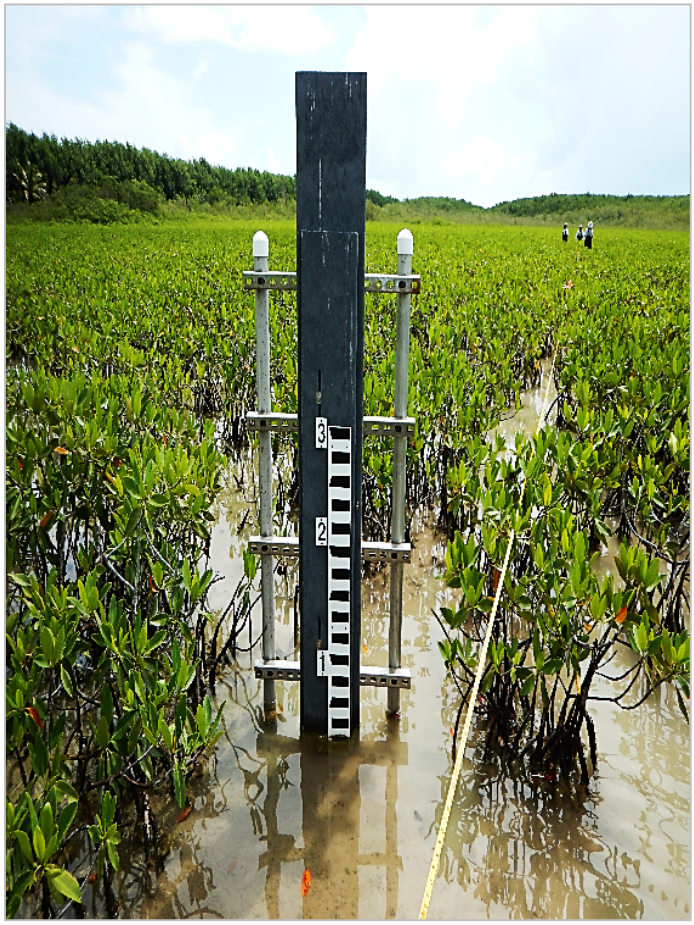


Figure 19. Wetland stage monitoring station S-23H.

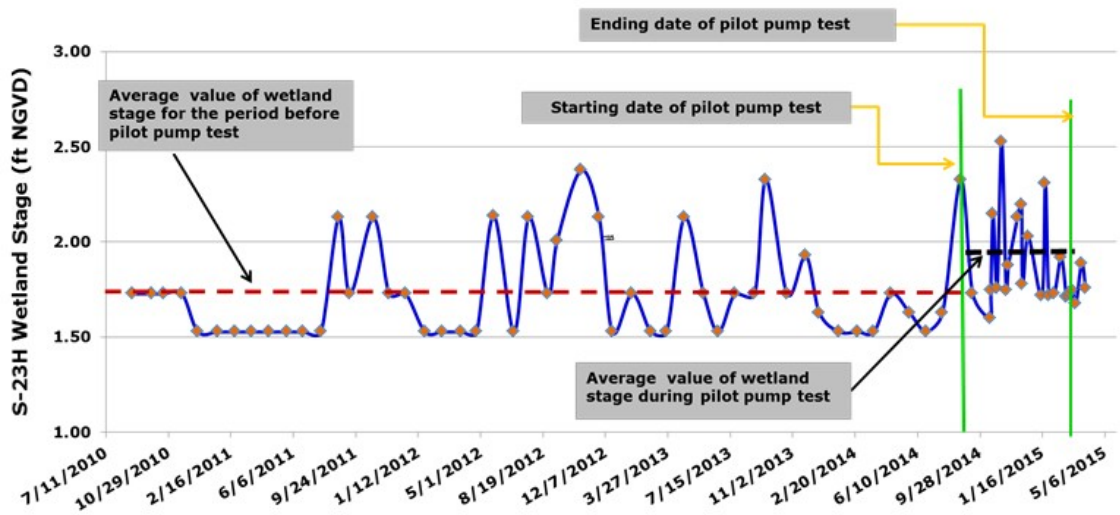


Figure 20. Summary of water levels at wetland stage monitoring station S-23H.

Rainfall

During WY2015, over 43 inches of rainfall were recorded at L-31E Culverts monitoring stations S-20F, S-21A, and S-20G (**Figure 21**).

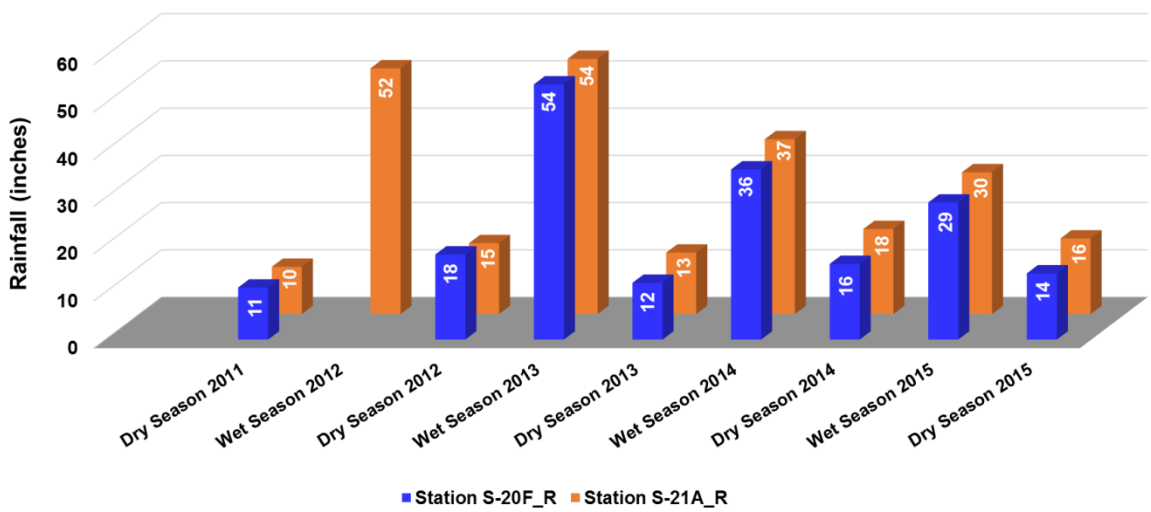


Figure 21. Rainfall during WY2011–WY2015 at stations near the L-31E Culverts. [Note: Dry season is November–April and wet season is May–October.]

DEERING ESTATE FLOW-WAY

Pump Station Operations

The Deering Estate Flow-way (**Figure 3**) redirects excess water from the C-100A canal system through the existing C-100A spur canal into the Cutler Drain on the project site and within the Deering Estate, thus restoring a portion of the historic freshwater flow through the Deering Estate and into Biscayne Bay. Goals and benefits of this component are described in the *Introduction* section of this report.

The operational intent is to maximize pumping when water is available (excess water in the C-100 basin) to improve the Deering Estate wetland ecosystem without adversely affecting water supply to local water users and groundwater levels. The station's operation is flexible to address various hydrologic conditions, and the coastal wetlands are monitored to measure any response, in accordance with the Ecological Monitoring Plan in Annex E of the Central and Southern Florida Project Comprehensive Everglades Restoration Plan Biscayne Bay Coastal Wetlands Phase I Final Integrated Project Implementation Report and Environmental Impact Statement (USACE and SFWMD 2012). Monitoring, data collection, and reporting are currently being coordinated between Miami-Dade County and the District. Normal operations will likely continue to be modified in the future to optimize the wetland benefits of the project.

When the project was designed, the operation of S-700 was expected to be controlled by a programmable logic controller (PLC) based on intake stage, which depends on S-123's operational mode and the water conditions. However, due to current programming limitations of the PLC unit at the site, operations of S-700 have been controlled by the operations control room at District headquarters. In the future, when more intelligent PLC programming is developed, tested, and deployed, the pump station's automatic controls for starting and sequencing of the pumps will be triggered by stage levels in the inlet canal to the pump station and other factors. The software governing the canal stage starting sequence may be modified in the future based on studying the hydrologic response and vegetative change (SFWMD 2014).

Although the station would normally be operated automatically in accordance with the inflow canal stage, it can be operated manually or remotely via telemetry communication facilities. These are alternatives to the pump on/off sequencing that accomplish the objective of an incremental increase of 25 cfs with an increase in stage. Pumps can be alternated as appropriate to equalize usage (SFWMD 2014).

During WY2015, S-700 diverted approximately 14,833 acre-feet of fresh water from the C-100 canal to the historic remnant wetlands near Cutler Creek east of Old Cutler Road in the form of sheetflow (**Figures 22** through **24**) and 1,289 acre-feet of water diverted through coastal structure S-123 (**Figure 25**). The WY2015 daily average discharge through S-700 was 56 acre-feet during the wet season (November–April) and 25 acre-feet during the dry season (May–October) (**Figure 22**). **Figure 23** compares stage and flow for S-700.

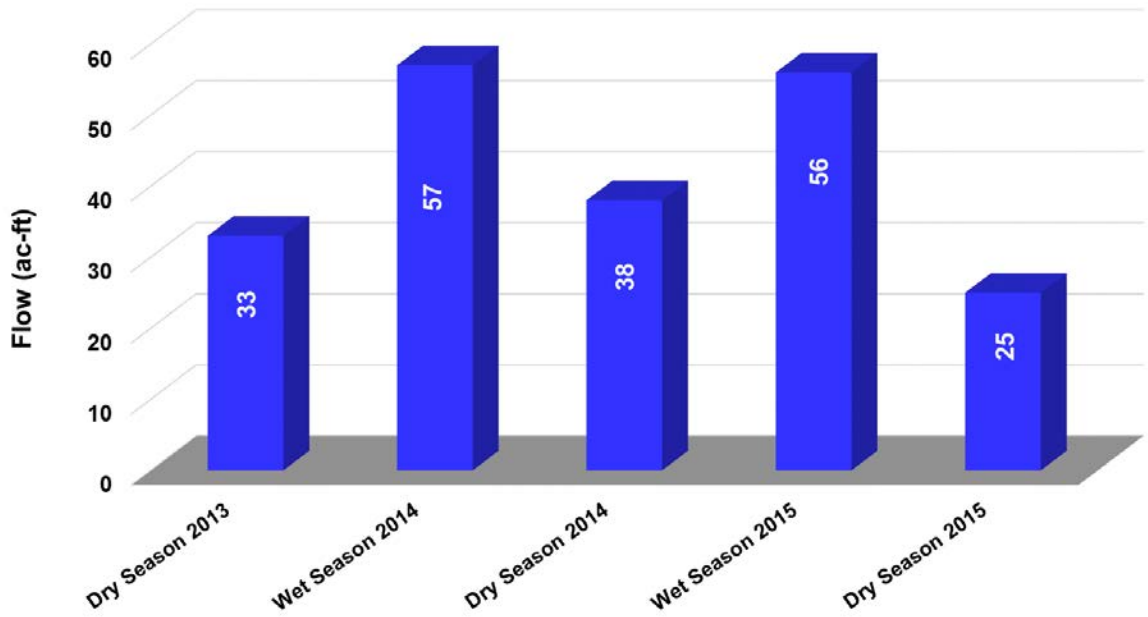


Figure 22. S-700 daily average discharge during WY2014 and WY2015 wet and dry seasons. [Note: Dry season is November–April and wet season is May–October.]

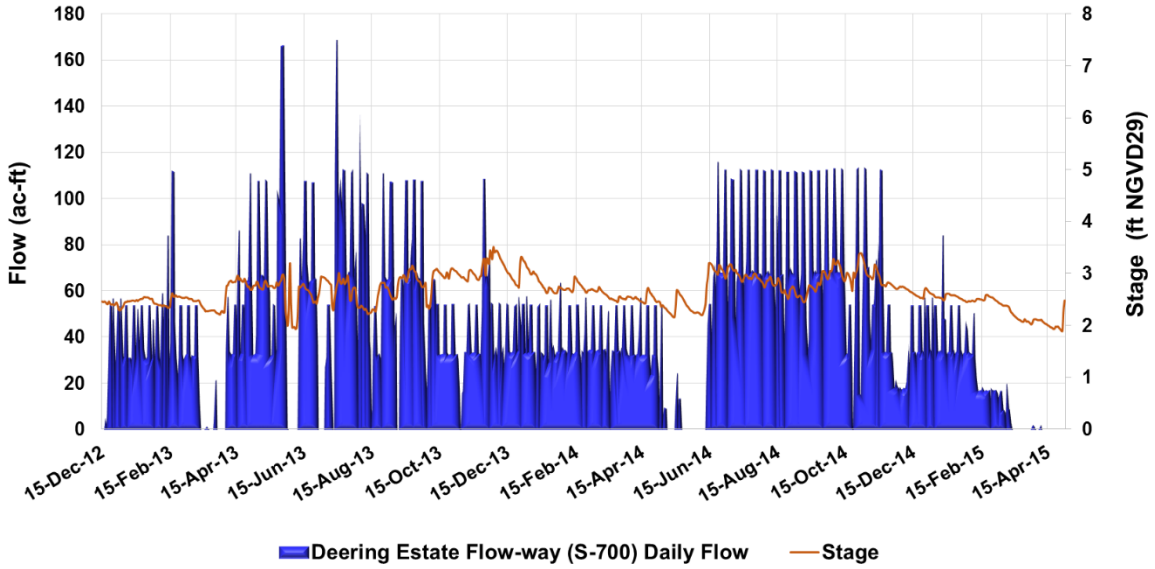


Figure 23. Deering Estate Flow-way Pump Station (S-700) flow in acre-feet (ac-ft) and stage in feet NGVD29 (ft.NGVD29) time series plot.

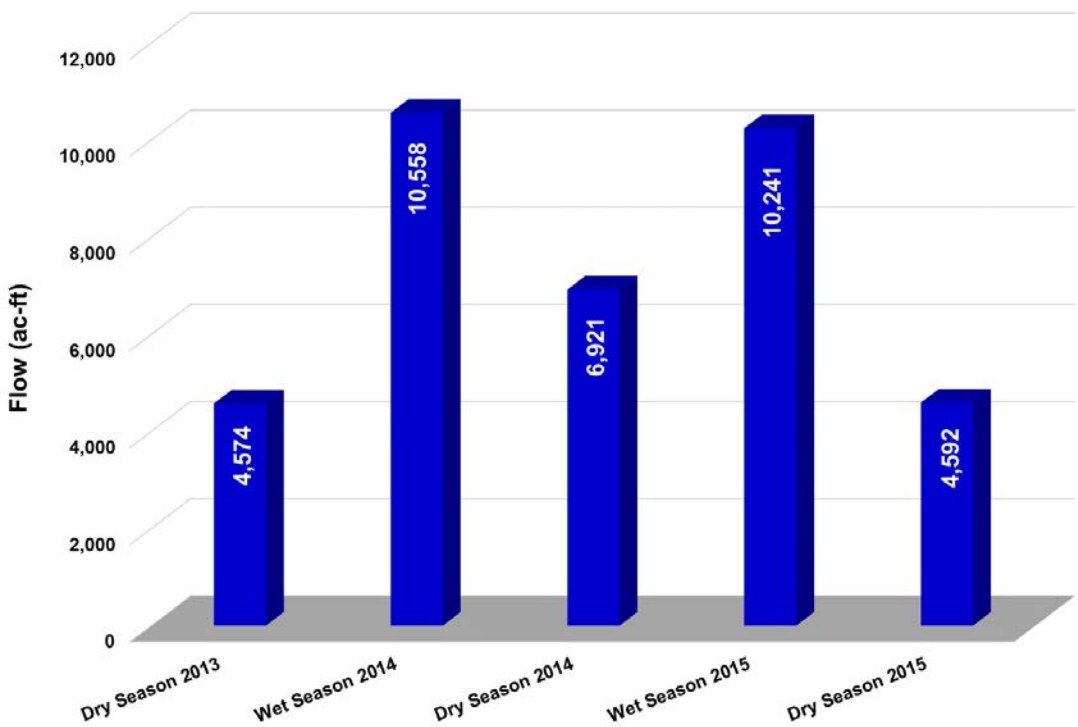


Figure 24. Deering Estate Flow-way pump station (S-700) wet and dry season discharges (ac-ft).
[Note: Dry season is November–April and wet season is May–October.]

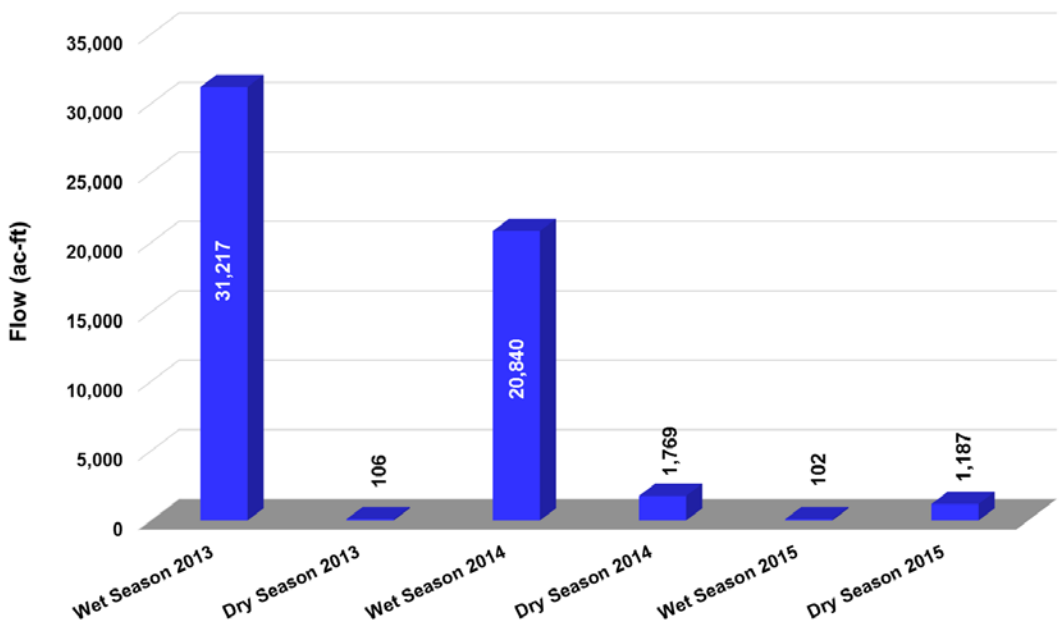


Figure 25. Wet and dry seasons total flow in acre-feet (ac-ft) through coastal structure S-123 within the vicinity of the Deering Estate Flow-way.
[Note: Dry season is November–April and wet season is May–October.]

Rainfall

During WY2015, 46 inches of rainfall was recorded at Deering Estate Flow-way station S-123 (**Figure 26**).

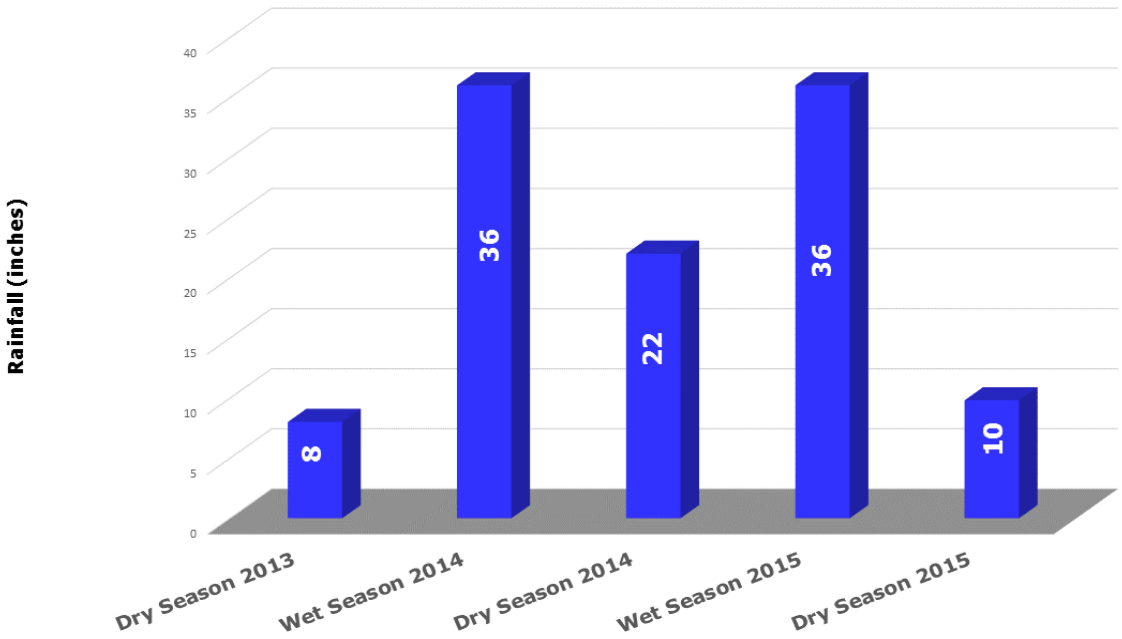


Figure 26. Summary of rainfall rain monitoring station S-123 within the vicinity of the Deering Estate Flow-way. [Note: Dry season is November–April and wet season is May–October.]

ECOLOGICAL MONITORING

Ecological monitoring is conducted for the BBCW project to assess progress toward achieving restoration goals. This section presents results of ecological monitoring conducted for the project for a number of associated parameters.

L-31E CULVERTS

In accordance with Specific Condition 28 of FDEP Permit Number 0271729-007, the District performed ecological monitoring at two of the four culvert (S-23A and S-23D) locations. Ecological conditions (salinity concentrations, water stages, wetland vegetation, and algal composition) in the L-31E Culverts area are anticipated to be enhanced by water deliveries.

Vegetation Monitoring

Vegetation monitoring was conducted using the line-intercept method to detect changes in the composition of vegetation transects in response to increased freshwater flows from the L-31E Culverts to the BBCW Project area (**Figures 27** and **28**). Species occurring as ground cover and canopy were tracked during this reporting period, including Category I and II invasive exotic plant species. The District has conducted vegetation monitoring since spring 2011 along two 100-meter transects downstream of Culverts S-23A and S-23D (**Figure 27**).

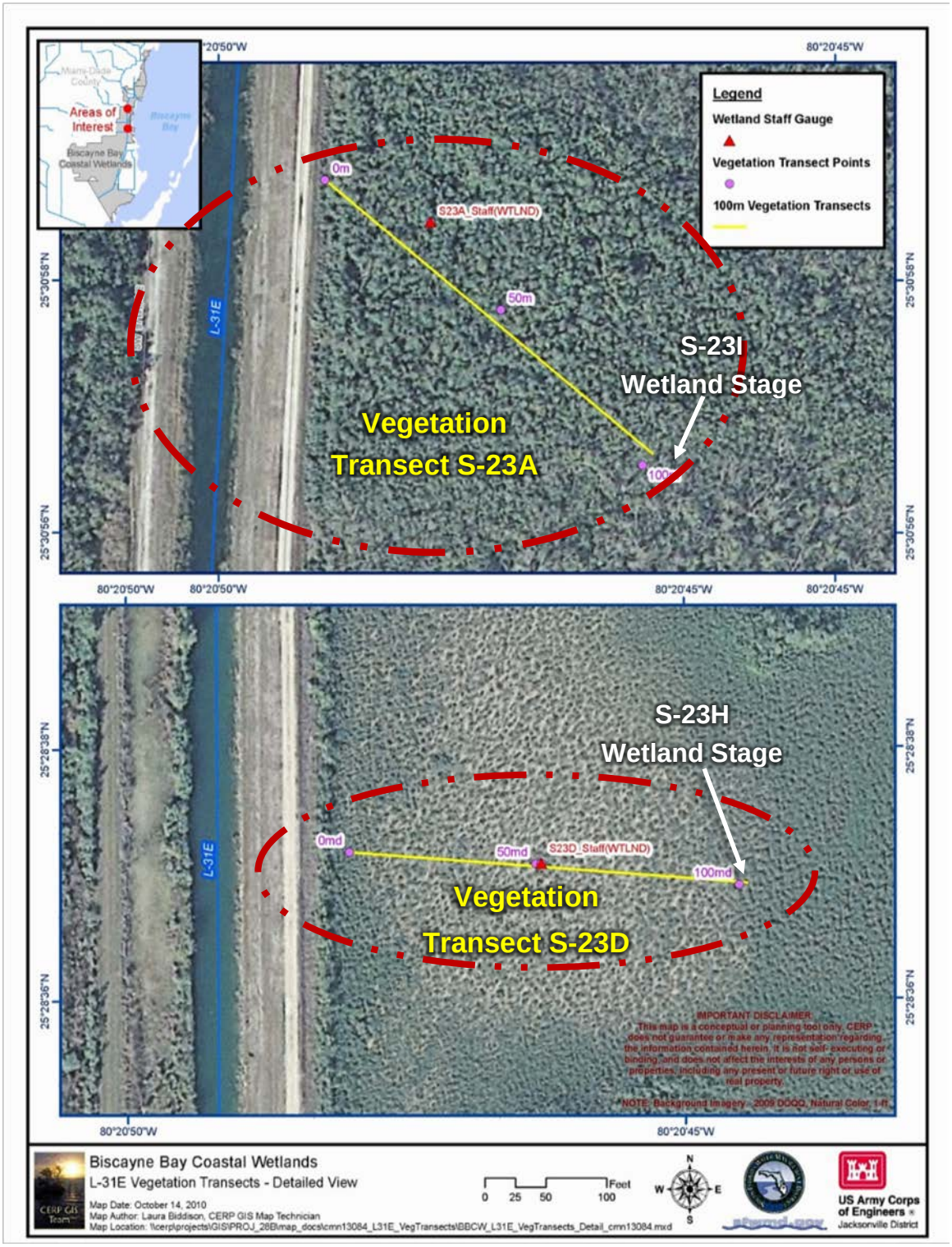


Figure 27. Location of 100-meter transects east of the levee at Culverts S-23A (top) and S-23D (bottom).

Figure 28. Vegetation monitoring along the transect within freshwater wetlands downstream of the S-23D culvert.

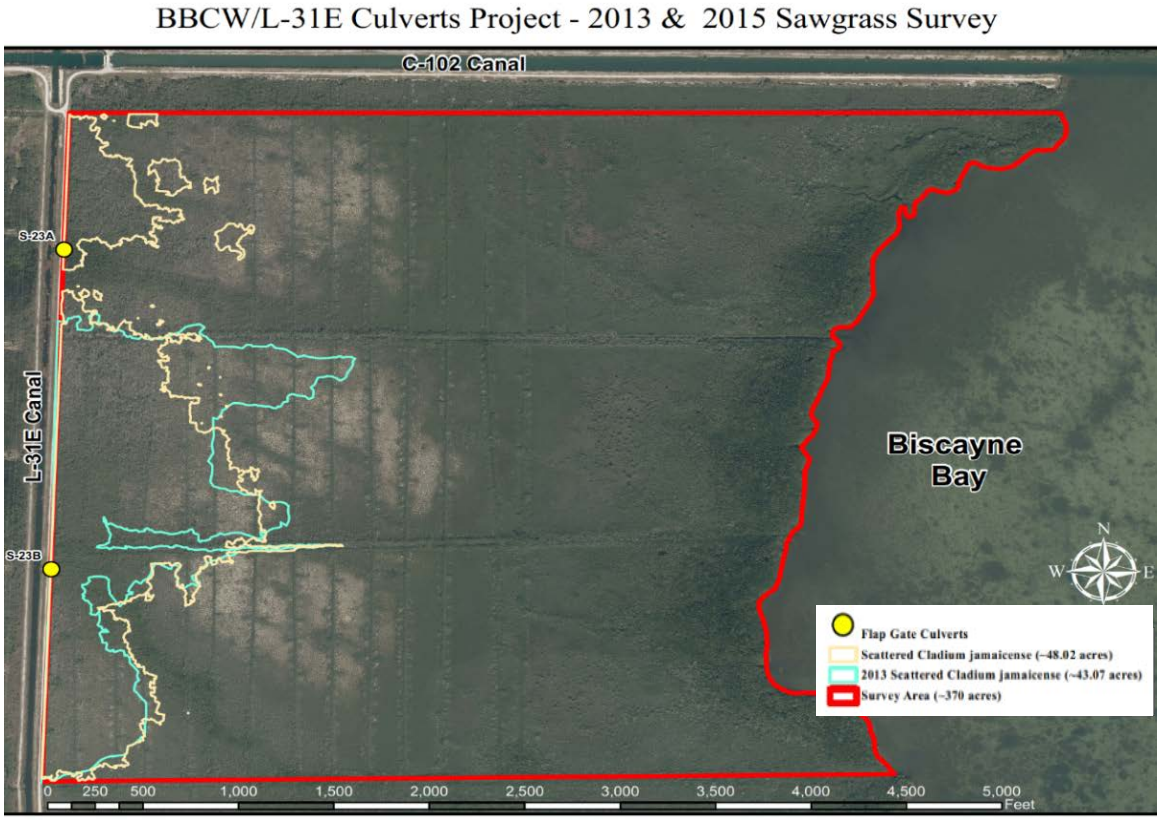
Overall, the existing vegetation along the two 100-meter transects located downstream of Culverts S-23A and S-23D appeared to be in better condition than in previous years. For example, the coverage of *Acrostichum aureum* has expanded to occupy locations along the transect located downstream of Culvert S-23A that were previously devoid of vegetation as a consequence of observer impacts associated with the monthly vegetation monitoring. Seedlings of *Annona glabra*, *Laguncularia racemosa*, and *Rhizophora mangle* have also recruited within these areas. The *A. glabra* seedlings are clustered around the parental trees, which are mostly restricted to the western portion of the area closest to the L-31E canal. The previously documented and persistent whitefly and sooty mold within the scrub red mangrove wetlands located downstream of Culvert S-23D have vanished, and the mangroves appeared to have more, and healthier foliage. During both semi-annual monitoring events in WY2015, periphyton was found ubiquitously encasing the submerged portions of the mangrove prop roots **Figure 29** (salinity concentration was less than 5). Sawgrass expansion has been observed within the project boundary east and west of the L-31E canal **(Figure 30)**. The District completed sawgrass mapping within 470 acres of Miami Dade-County Preserve wetlands **(Figure 31)** in February 2015, and noted an increase in sawgrass acreage assessed from 43.07 acres (2013 mapping) to 48.02 (2015 mapping) **Figure 31.**

Table 8 depicts a slightly decreasing trend for the wet and dry seasons, with variations attributed to the following:

- Seasonal changes (e.g., defoliation and/or dieback of lateral branches following the December 2010 and January 2015 cold snaps)
- Natural senescence
- White fly infestation and observed loss of foliar tissue and apparent decline of red mangroves during this period

Figure 29. Periphyton throughout scrub mangrove wetlands downstream of the S-23D culvert.

Figure 30. Expansion of sawgrass downstream of the S-23C culvert, east and west of the L-31E canal.



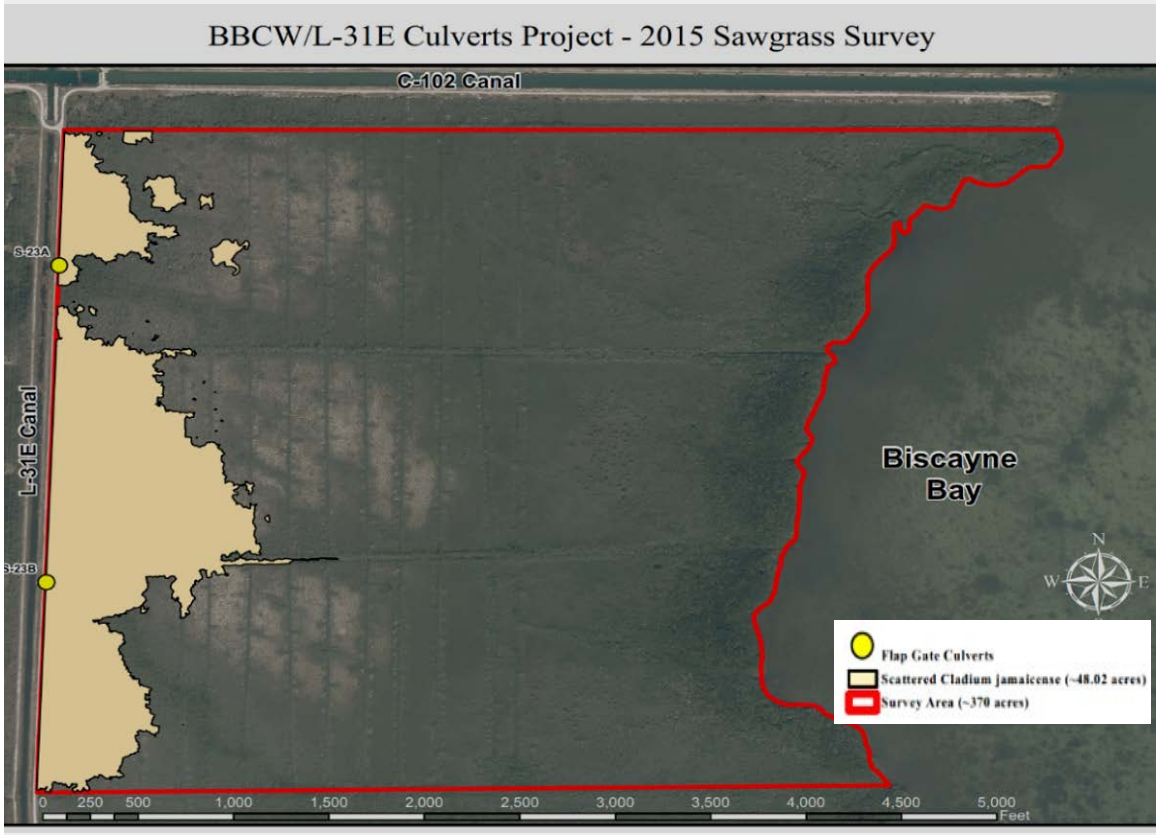


Figure 31. 2015 sawgrass mapping east of the L-31E levee.

Table 8. S-23A and S-23D vegetation mean percent cover.
[Note: Dry season is November–April and wet season is May–October.]

Species	WY2010–WY2011		WY2011–WY2012		WY2012–WY2013		WY2013–WY2014		WY2014–WY2015	
	Baseline	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
S-23A Canopy										
Rhizophora mangle (red mangrove)	71.8	70.12	74.63	75.83	74.33	73.18	71.65	75.25	76.23	74.4
Conocarpus erectus (buttonbush)	41.5	44.43	51.1	56.77	63.42	57.55	51.07	39.43	49.28	44.2
S-23A Groundcover										
Rhizophora mangle (red mangrove)	28.0	33.8	30.4	24.5	17.1	15.8	24.9	25.7	17.0	19.4
Acrostichum aureum (golden leather fern)	39.0	28.8	34.3	36.8	34.3	19.7	24.1	20.2	25.5	24.5
Conocarpus erectus (buttonbush)	6.5	4.5	7.3	6.6	5.4	5.8	7.4	7.5	6.5	12.5
Cladium jamaicense (sawgrass)	6.5	9.0	0.0	3.4	4.2	3.3	4.6	4.1	4.2	4.0
S-23D Groundcover										
Rhizophora mangle (red mangrove)	79.8	79.5	75.8	71.5	70.8	69.3	65.4	61.4	60.0	49.1

Aquatic Web Food Monitoring

An increased abundance of various bird species, amphibians, invertebrates, and fish was observed in WY2015. Several species of freshwater fish were observed east of the L-31E canal, including Mayan cichlids (*Cichlasoma urophthalmus*), eastern mosquito fish (*Gambusia holbrooki*), pike killifish (*Belonesox belizanus*), striped mullet (*Mugil cephalus*), blue crabs, and spotted tilapia (*Tilapia mariae*) (**Table 9**; **Figures 32** and **33**). Numerous wading birds congregated in the scrub red mangrove wetlands during the pump test (**Figure 33**), including great egrets (*Ardea alba*), wood storks (*Mycteria americana*), and white ibis (*Eudocimus albus*).

Table 9. Various fauna species observed within the vicinity of the S-23A and S-23D L-31E Culverts during WY2015.

Type	Species	Common Name
	Culvert S-23A	
Invertebrates	*Gasteracantha cancriformis*	Spiny orb weaver spider
	Leucauge venusta	Orchard orb weaver spider
Amphibians	None	
Reptiles	None	
Birds	*Dumetella carolinensis*	Gray catbird
	Pandion haliaetus	Osprey
Fish	*Poecilia latipinna*	Sailfin molly
Observations	Raccoon (*Procyon lotor*) scat along transect. Dense clusters of *Schinus* seedlings originating from raccoon.	
	Culvert S-23D	
Invertebrates	None	
Amphibians	None	
Reptiles	None	
Birds	*Eudocimus albus*	American white ibis (>10)
	Mycteria americana	Wood stork (3)
	Ardea alba	Great egret (>10)
Fish	*Mugil cephalus*	Striped Mullet
	Belonesox belizanus	Pike killifish
	Gambusia holbrooki	Eastern mosquitofish
	Tilapia mariae	Spotted tilapia
	Cichlasoma urophthalmus	Mayan cichlid
Observations	Numerous wading birds congregating in the scrub red mangrove wetlands	

Figure 32. Numerous blue crab species were observed east of the L-31E canal during the pump test.

Figure 33. Numerous wading birds congregating in the scrub red mangrove wetlands east of the L-31E canal.

Tidal Wetland Salinity Monitoring

During the L-31E Pilot Pump Test, salinity was recorded directly upstream, directly downstream, and 30 meters downstream of the S-23C culvert, and along the S-23D vegetation transect (**Figures 2, 34,** and **35**). Salinity responded to the input of fresh water in the wetland east of the L-31E canal. Results indicated a lag effect in the relationship between the discharge of fresh water and salinity response within the wetland. Salinity along both the S-23C and S-23D transects decreased to less than 5 during this event (**Figures 34** and **35**).

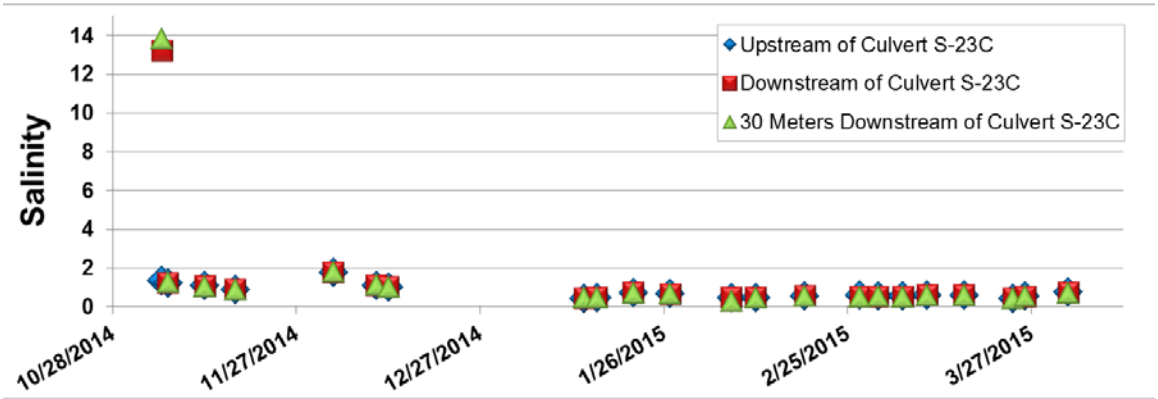


Figure 34. Salinity upstream, downstream, and 30 m downstream of culvert S-23C.

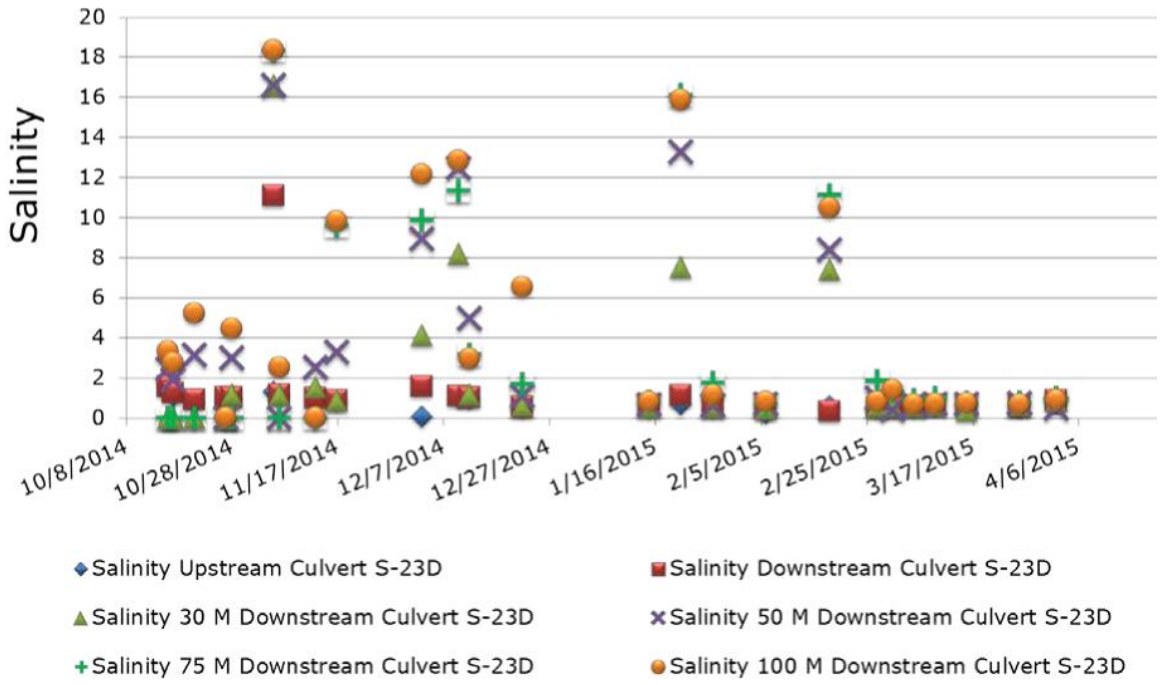


Figure 35. Comparison of salinity at various locations along S-23D 100-meter transect.

Nearshore Salinity Monitoring

Continuous salinity monitoring has been conducted since 2006 in the coastal region near the L-31E Culverts, along the shore between the Military and C-103 canals. Monitoring for the L-31E Culverts leverages existing CERP RECOVER salinity monitoring stations in Biscayne Bay, as described in **Table 10** and **Figure 36**. Salinity was collected at these stations at 15-minute intervals from sensors located on the bay bottom within 500 meters of the shore. **Table 11** presents summary statistics of nearshore daily mean salinity in Biscayne Bay as well as total freshwater input and total rainfall during the WY2011–WY2015 dry seasons.

Table 10. Location and description of nearshore salinity monitoring stations.

Site Name	Latitude	Longitude	Deployment Type	Site Description	Site*	Period of Record
BISC14	25.4736	-80.3400	Bottom	South Biscayne Bay 300 meters north of C-103 Canal 50 meters offshore	14	March 2004 to current
BISC16	25.4726	-80.3378	Bottom	South Biscayne Bay 250 meters north of C-103 Canal 300 meters offshore	16	March 2004 to current
BISC22	25.4924	-80.3391	Bottom	South Biscayne Bay 400 meters north of Military Canal 100 meters offshore	22	March 2004 to current
BISCA8	25.4813	-80.3397	Bottom	Central Biscayne Bay south of Military Canal 50 meters offshore	A8	2010 to current

* Numbers correspond to monitoring sites shown in Figure 36.

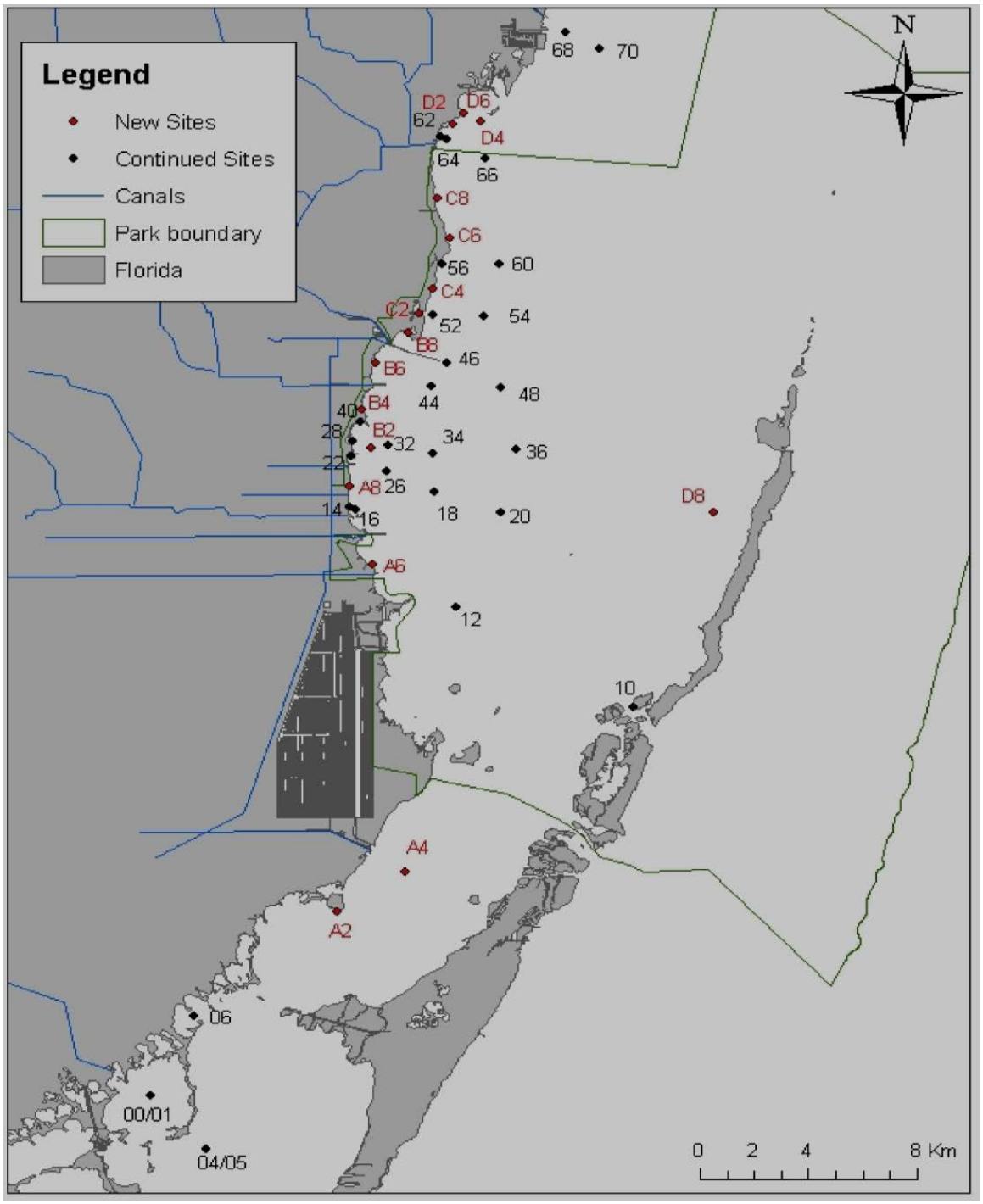


Figure 36. CERP salinity monitoring network within vicinity of the BBCW Project. Note: Stations BISC14, BISC16, BISC22, and BISCA8 are sites 14, 16, 22, and 8, respectively. More information about these four sites is presented in Table 10.

Table 11. Summary of daily mean salinity at stations BISCA8, BISC14B, BISC16B, and BISC22; total flow at S-20F, S-23C and S-23D; and total rainfall during WY2011–WY2015 dry seasons. [Note: Dry season is November–April.]

Dry Season	Daily Mean Salinity						Total Flow (acre-feet)		Total Rain (inches)
	n	Arithmetic Mean	Standard Deviation	Minimum	Median	Maximum	S-20F	Sum of S-23C and S-23D	S-20F
WY2011	905	25.80	7.12	3.62	25.91	39.96	39,199	0	10.71
WY2012	759	19.25	7.75	4.80	18.59	37.09	59,590	253	17.59
WY2013	880	24.04	5.41	8.14	24.56	35.67	57,034	125	12.08
WY2014	762	23.47	6.40	5.16	23.40	38.46	69,211	116	15.53
WY2015	897	24.86	6.74	9.63	24.18	42.76	44,660	4,154	14.23

In **Figure 37**, the narrowest parts of the boxes represent the median salinities, and the notches indicate the 95 percent confidence interval around the medians. The black dashed lines show the 95 percent confidence interval around the WY2015 dry season median salinity. There was practically no difference between the median salinity of dry seasons from WY2013 through WY2015. However, the median salinity during the WY2011 dry season was higher than the rest of the years, while the median salinity during the WY2012 dry season was lower than the other years (**Figure 37**).

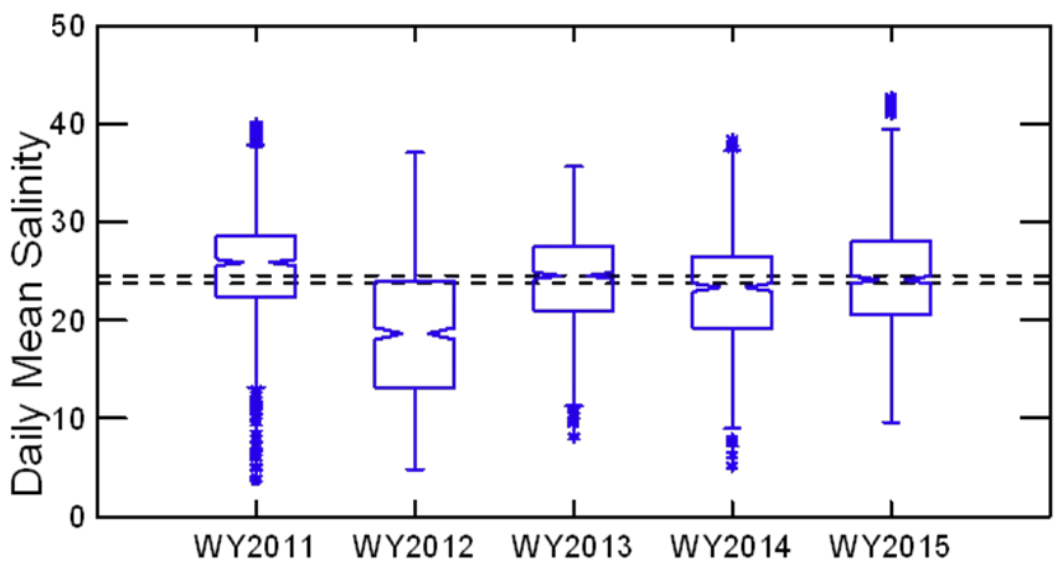


Figure 37. Box plots of daily mean salinity at BISCA8, BISC14B, BISC16B, and BISC22 in nearshore Biscayne Bay during the WY2011–WY2015 dry seasons. [Note: The dashed lines represent the 95 percent confidence interval around the WY2015 dry season median. Dry season is November–April. More information about how to read box plots is provided in Figure 8.]

The WY2011 dry season had the highest salinity and the lowest rainfall and lowest amount of freshwater input into Biscayne Bay, while the WY2012 dry season had the lowest salinity, highest amount of rainfall, and the second largest amount of freshwater input into Biscayne Bay. No conclusions can be inferred regarding the influence of freshwater input diverted through S-23C and S-23D on nearshore Biscayne Bay salinity because this discharge only represented a very small percentage of the total flow dispersed through S-20F (about 0.21% cumulative during all dry seasons).

DEERING ESTATE FLOW-WAY

In accordance with Specific Condition 28B of FDEP permit 0271729-007, ecological monitoring events are conducted by the District and Miami-Dade County Permitting, Environmental, and Regulatory Affairs staff to evaluate the performance of the Deering Estate Flow-way, which is anticipated to result in higher water levels in Cutler Creek and wetlands within Deering Estate. Increased water levels are the result of operation of constructed features of the project. Monitoring must be conducted for at least three years after completion of construction of the pump station.

Four monitoring stations are used for the Deering Estate Flow-way water level and flow monitoring (**Table 12** and **Figure 38**). Stations 1 and 3 are wetland staff gauges, and stations 2 and 5 are groundwater monitoring wells (**Figures 3** and **38**).

Table 12. Ecological monitoring station locations for the Deering Estate Flow-way.

Station Name	Area Description	Latitude Approximate X Coordinates	Longitude Approximate Y Coordinates	Function/ Description	Monitoring Well Information	
					Top of Casing Elevation (ft NGVD)	Rim (feet)
Station 1	Within the Rehydration Area	885124.742	469012.886	Staff gauge	NA*	NA
Station 3		885363.133	468759.938		NA	NA
Station 5	Within the Rehydration Area	885729.49	468718.07	Groundwater monitoring well	8.53	8.78
Station 2		883587.85	469241.68		10.3	10.61
CC2	Deering Estate Flow-way Creeks	-80.301557	25.617813	In situ multi-parameter (YSI) at bottom of creek	NA	NA
CC3		-80.302131	25.620023		NA	NA
DNC01		-80.299739	25.621378		NA	NA

* NA - Not applicable

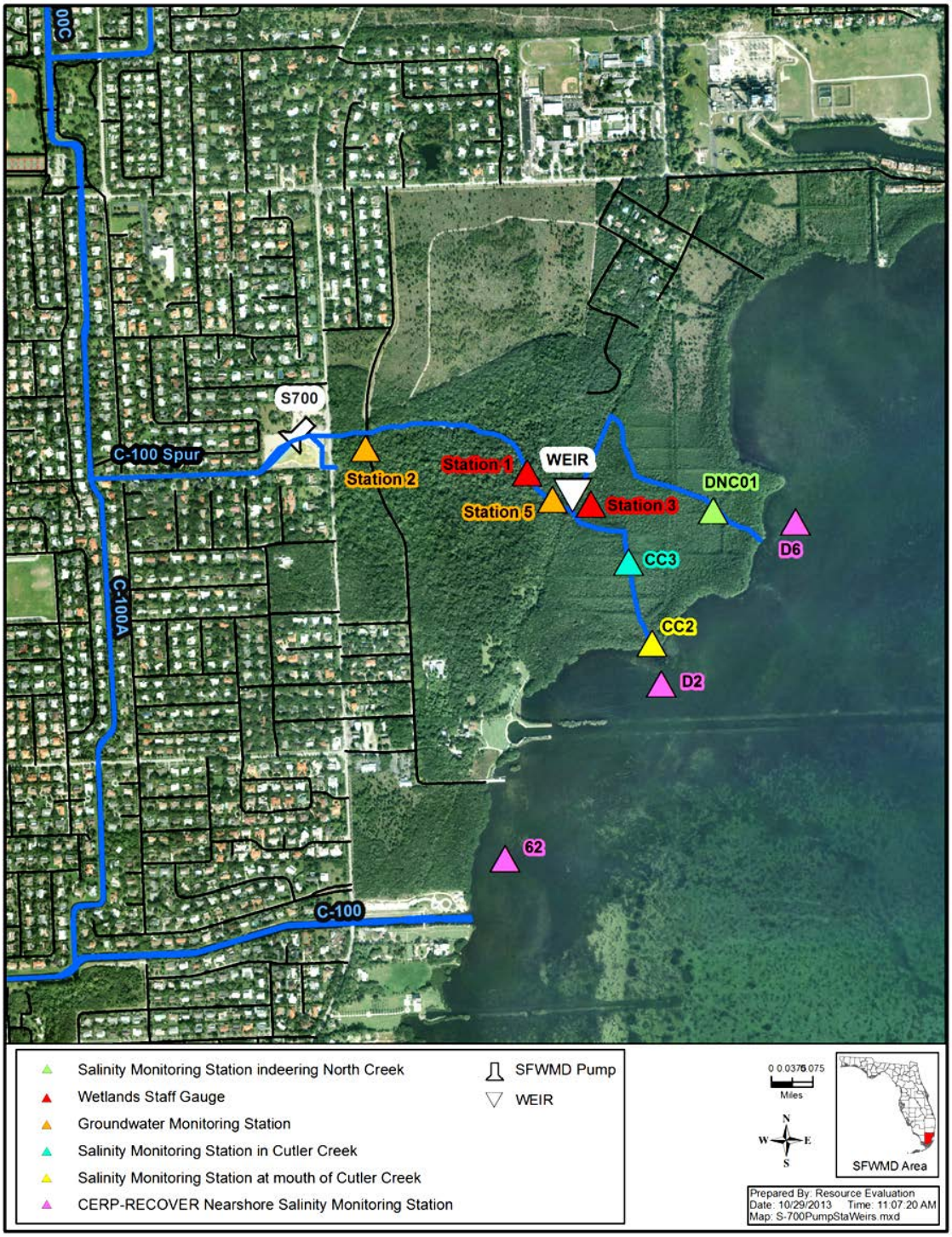


Figure 38. Ecological monitoring stations for the Deering Estate Flow-way.

Surface Water Levels (Wetlands Stage)

Once pumping began, surface water levels within the wetlands increased at staff gauges 1 and 3 after a few days lag, and decreased after pumping ceased (**Table 13** and **Figure 39**). The greatest increase in water level, a maximum average rise of about 3.86 feet, occurred at wetland staff gauge 1.

Table 13. Monthly stage within the Deering Estate wetlands during WY2015.

Month	Stage (feet NGVD)	
	Wetland Staff Gauge 1	Wetland Staff Gauge 3
May 2014	1.74	1.54
Jun. 2014	3.48	2.48
Jul. 2014	3.9	2.52
Aug. 2014	3.86	2.9
Sep. 2014	3.84	2.5
Oct. 2014	2.82	2
Nov. 2014	2.8	2.64
Dec. 2014	2.58	2.42
Jan. 2015	2.5	1.82
Feb. 2015	2.5	1.58
Mar. 2015	2.8	1.44
Apr. 2015	1.62	1.42

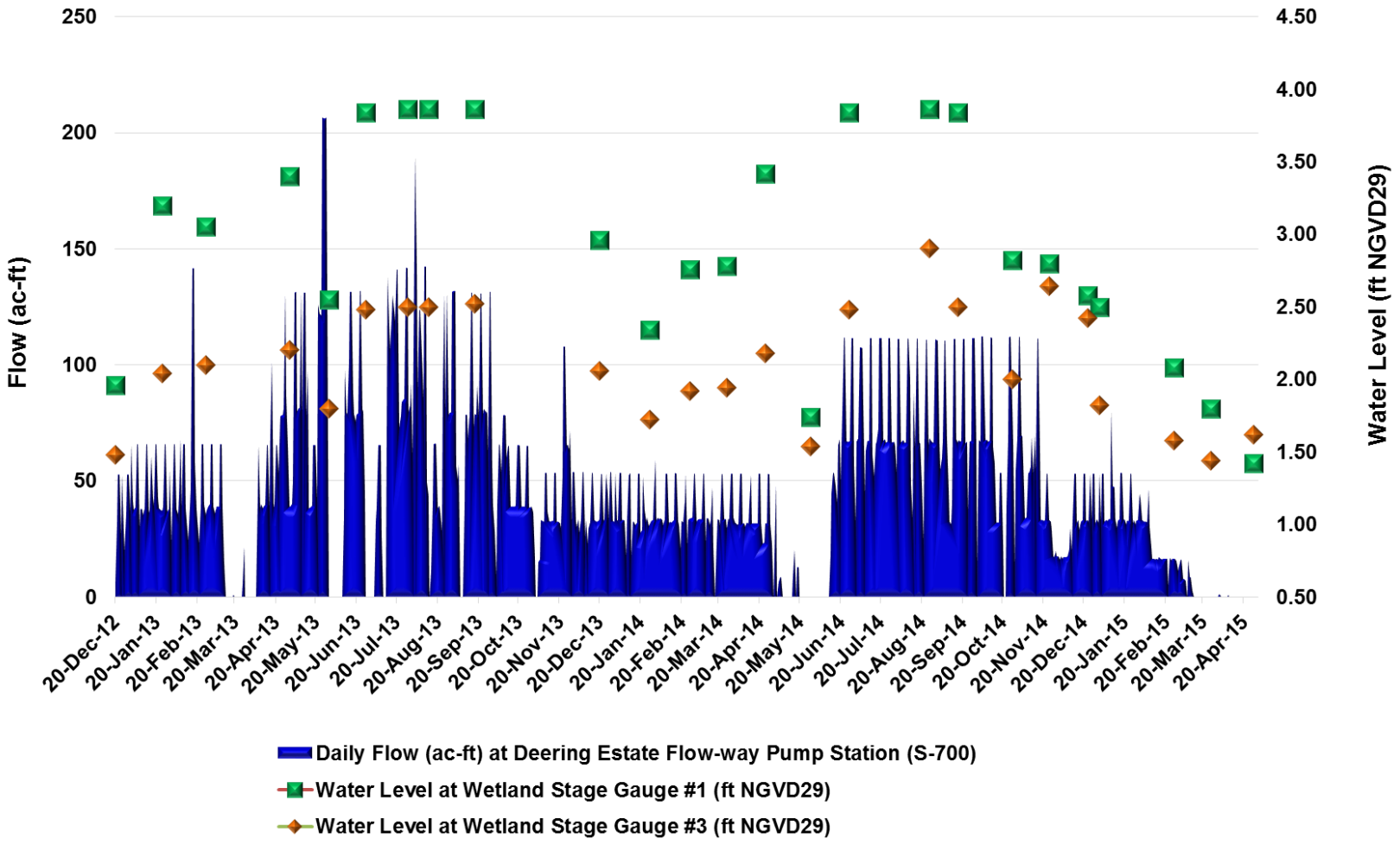


Figure 39. Water levels at Deering Estate staff gauges 1 and 3 versus S-700 daily flow and stage.

Surface Water Salinity

Surface water salinity decreased in response to the pumped input of fresh water from S-700 into the historic remnant wetlands near Cutler Creek (**Table 14**). Salinity at wetland staff gauges 1 and 3 decreased to less than 1 in response to the pumped input of fresh water from S-700 (**Figure 40**).

Table 14. Monthly surface water salinity near the Deering Estate rehydration area during WY2015.

Date	Surface Water Salinity	
	Wetland Staff Gauge 1	Wetland Staff Gauge 3
May 2014	0.45	8.55
Jun. 2014	0.26	0.26
Jul. 2014	0.27	0.26
Aug. 2014	0.26	0.26
Sep. 2014	0.27	0.27
Oct. 2014	0.29	0.29
Nov. 2014	0.27	1.76
Dec. 2014	0.28	0.31
Jan. 2015	0.28	0.33
Feb. 2015	0.26	0.91
Mar. 2015	0.36	9.61
Apr. 2015	0.02	5.34

Groundwater Levels (Groundwater Stage)

Groundwater rose noticeably at stations 2 and 5, and water levels varied according to pump operations (**Figure 41**). Monitoring station 2 is located about 360 feet downstream of the S-700 pump station discharge. The response of levels downstream at groundwater monitoring station 5 was muted by comparison, but appeared to rise slightly in response to pumped discharges, and became less variable (**Figure 42**).

Groundwater Salinity

Groundwater salinity also responded to the input of fresh water from S-700 into the historic remnant wetlands (**Figure 42**). Salinity rose rapidly at the beginning of the dry season at groundwater monitoring station 5 near the mangrove wetlands, peaking at well over 20. After pumping began at S-700, salinity decreased to less than 10. The salinity concentration at groundwater monitoring station 2 was less than 1 during this reporting period (**Figures 3** and **42**)

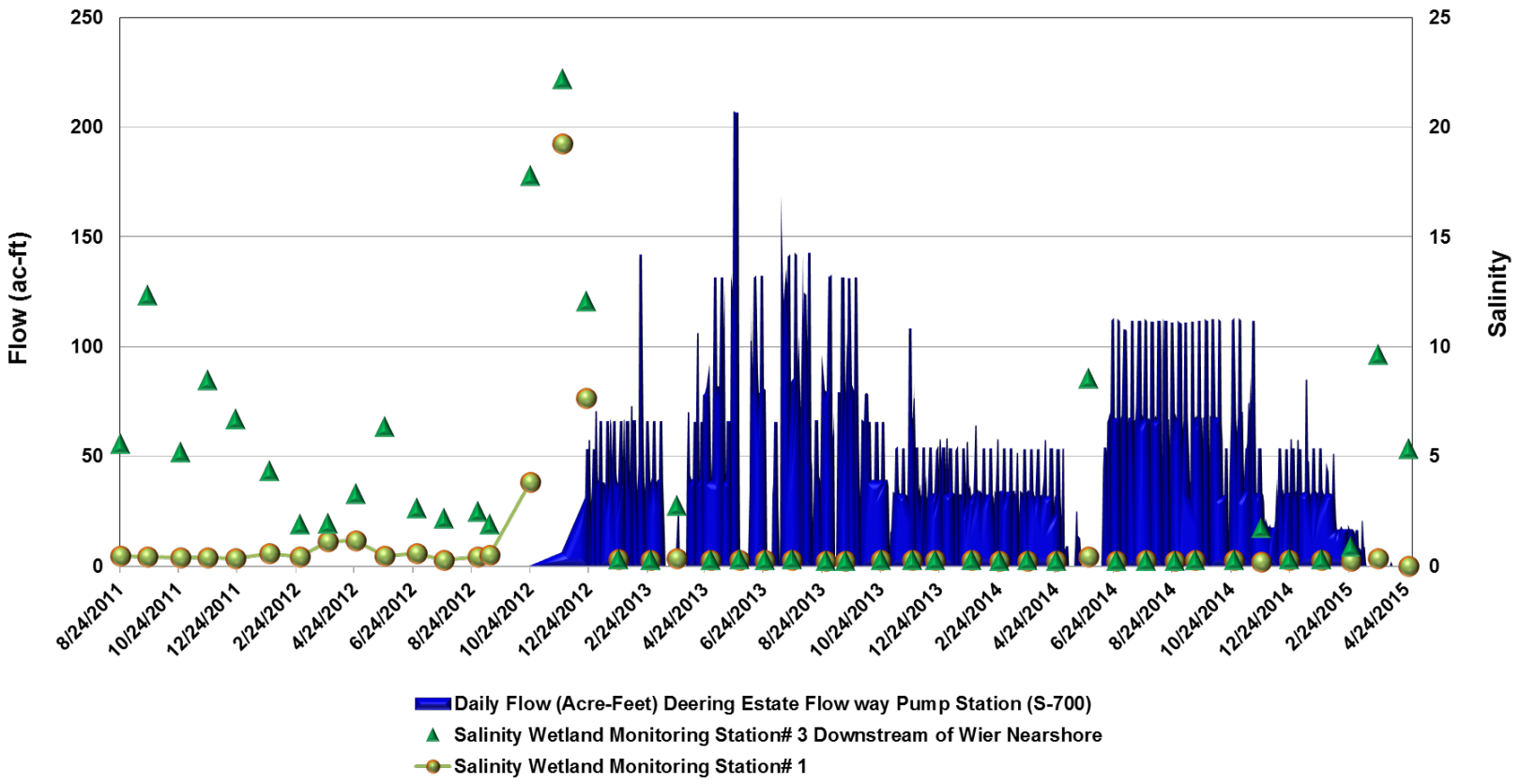


Figure 40. Surface water salinity at Deering Estate wetland staff gauges 1 and 3 versus S-700 daily flow in acre-feet (ac-ft).

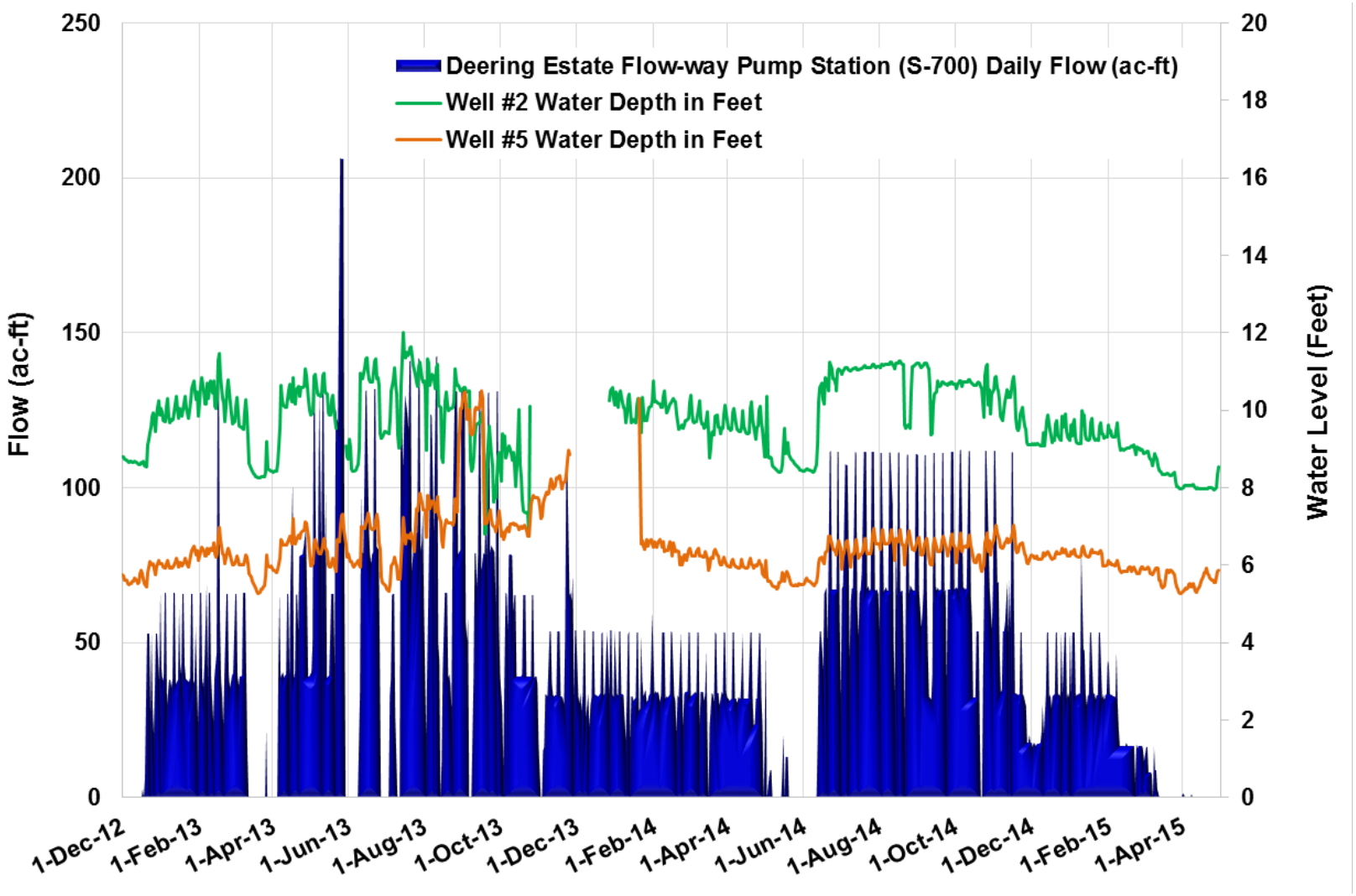


Figure 41. Groundwater levels in acre-feet (ac-ft) near Deering Estate historic remnant wetlands.

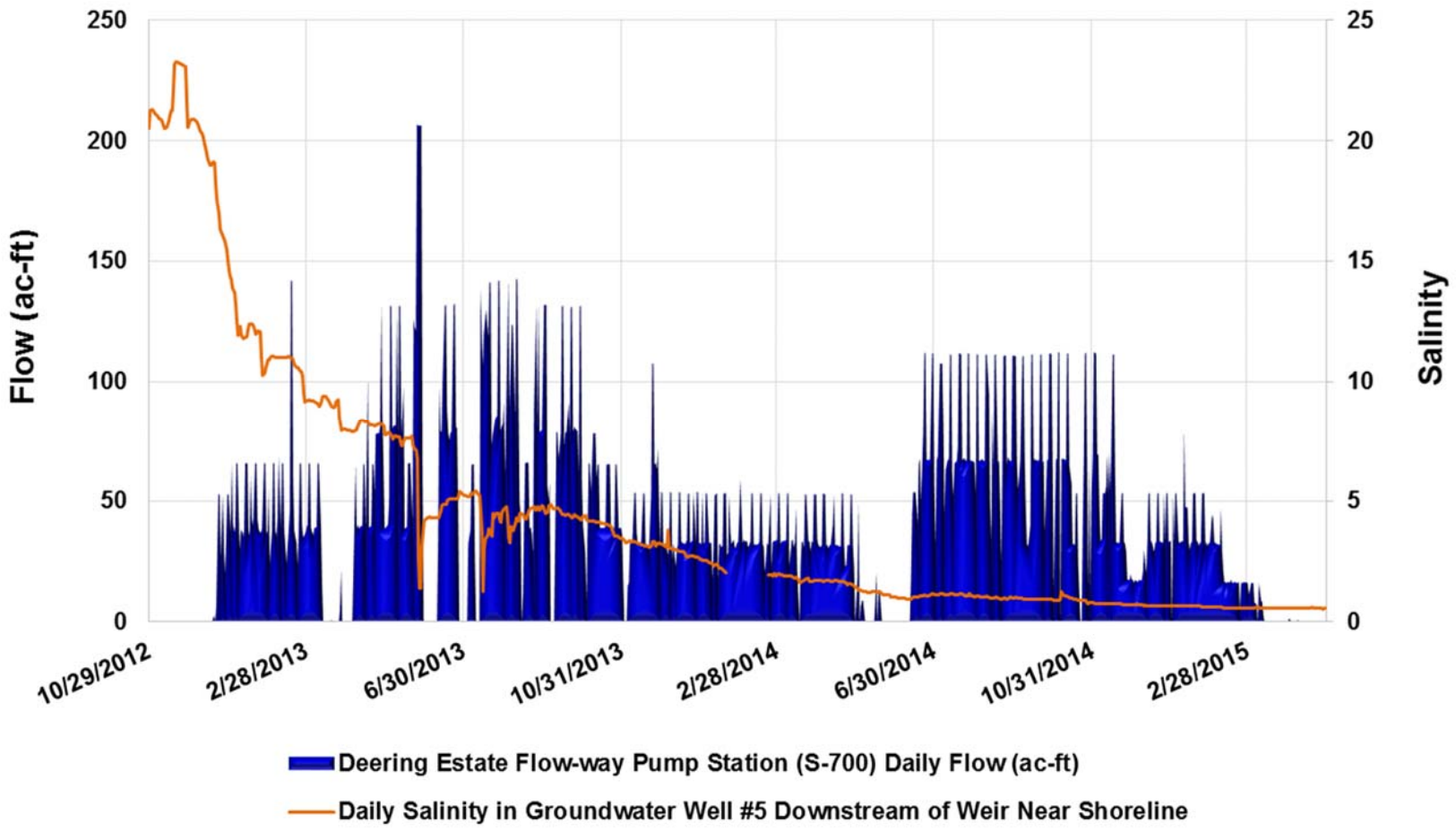


Figure 42. Comparison of salinity concentrations in groundwater well 5 near the historic remnant wetlands of Deering Estate versus S-700 daily flow in acre-feet (ac-ft).

Nearshore Salinity Monitoring

Continuous salinity monitoring has been conducted since 2004 in the coastal region near the Deering Estate Flow-way at stations BISC62, BISCD2, and BISCD6 (**Table 15** and **Figures 36** and **38**). Salinity is collected at these stations at 15-minute intervals from sensors located on the bay bottom within 500 meters of the shore.

Table 15. Location and description of nearshore salinity monitoring stations.

Site Name	Latitude	Longitude	Deployment Type	Description	Site	Period of Record
BISC62	25.61225	-80.30583	Bottom	Mouth of C-100 Canal	62	March 2004 to current
BISCD2	25.61678	-80.3013	Bottom	Nearshore of Deering Estate	D2	2010 to current
BISCD6	25.62097	-80.2974	Bottom	Nearshore of Deering Estate	D6	2010 to current

Salinity Monitoring in Historical Creeks Nearshore of Deering Estate Flow-way

Continuous salinity monitoring has been conducted since 2013 inside historical creeks and at the mouth of Cutler Creek in the Deering Estate Flow-way. Deering Estate creeks salinity monitoring stations are CC2, CC3, and BNC01 (**Figure 38**). Salinity was collected at these stations at 15-minute intervals from sensors located on the creek bottom.

Table 16 presents basic statistics of daily mean salinity at two regions near Deering Estate: Deering Estate creeks and the Biscayne Bay nearshore area. The stations representing the salinity in Deering Estate creeks region are CC2, CC3, and DNC01, while the nearshore stations are BISC-62, BICS-D2, and BISC-D6. **Table 17** presents total flow at S-700 and S-123, and total rainfall at S-123 for November 1, 2012, to April 30, 2015, by season and water year. This information is plotted in **Figures 43** and **44.**

Table 16. Basic statistics of daily mean salinity in Deering Estate creeks and nearshore area for November 1, 2012–April 30, 2015, by season (D – dry and W – wet) and water year.
[Note: Dry season is November–April and wet season is May–October.]

Region	Interval	Daily Mean Salinity									
		n	Mean	Standard Deviation	Minimum	25%	50%	75%	Maximum	Low 95%	Up 95%
Cutler Creeks	WY2013 D	6	22.51	1.38	20.57	21.38	22.64	23.91	23.95	21.00	24.27
Cutler Creeks	WY2014 W	259	15.80	5.88	3.18	11.07	15.26	20.69	32.47	14.32	16.20
Cutler Creeks	WY2014 D	533	22.68	4.01	11.58	20.04	23.24	25.00	33.04	22.90	23.58
Cutler Creeks	WY2015 W	368	25.12	6.78	8.85	19.92	23.87	31.74	37.03	22.90	24.84
Cutler Creeks	WY2015 D	537	27.04	3.25	13.65	25.02	27.20	29.76	34.61	26.88	27.52
Nearshore	WY2013 D	529	28.46	2.73	19.8	26.80	28.37	30.83	33.68	28.09	28.65
Nearshore	WY2014 W	359	26.47	4.25	11.19	24.46	26.86	29.45	35.00	26.44	27.28
Nearshore	WY2014 D	529	27.42	2.76	19.01	25.72	26.98	29.11	33.75	26.75	27.21
Nearshore	WY2015 W	408	29.41	3.78	19.31	26.99	29.17	31.86	38.10	28.78	29.55
Nearshore	WY2015 D	529	29.50	2.49	23.62	27.78	29.51	30.85	36.76	29.30	29.72

Table 17. Total flow at S-700 and S-123, and total rainfall at S-123 by season and water year (November 1, 2012, to April 30, 2015). [Note: Dry season is November–April and wet season is May–October.]

Interval	Total Flow (1,000 x acre-feet)		Total Rainfall (inches)
	S-700	S-123	S-123
WY2013 Dry	4.57	0.11	8.03
WY2014 Wet	10.56	20.84	36.20
WY2014 Dry	6.92	1.76	22.00
WY2015 Wet	10.24	0.10	34.07
WY2015 Dry	4.59	1.19	11.76

Figure 43 presents box plots of daily mean salinity in Deering Estate creeks and nearshore areas. The narrowest parts of the boxes represent the medians, and the notches indicate the 95 percent confidence interval around the medians. The red dotted lines indicates the 95 percent confidence interval around the WY2015 dry season median salinity. Note that WY2015 dry season medians have the highest value out of all analyzed intervals in in Deering Estate creeks as well as nearshore areas.

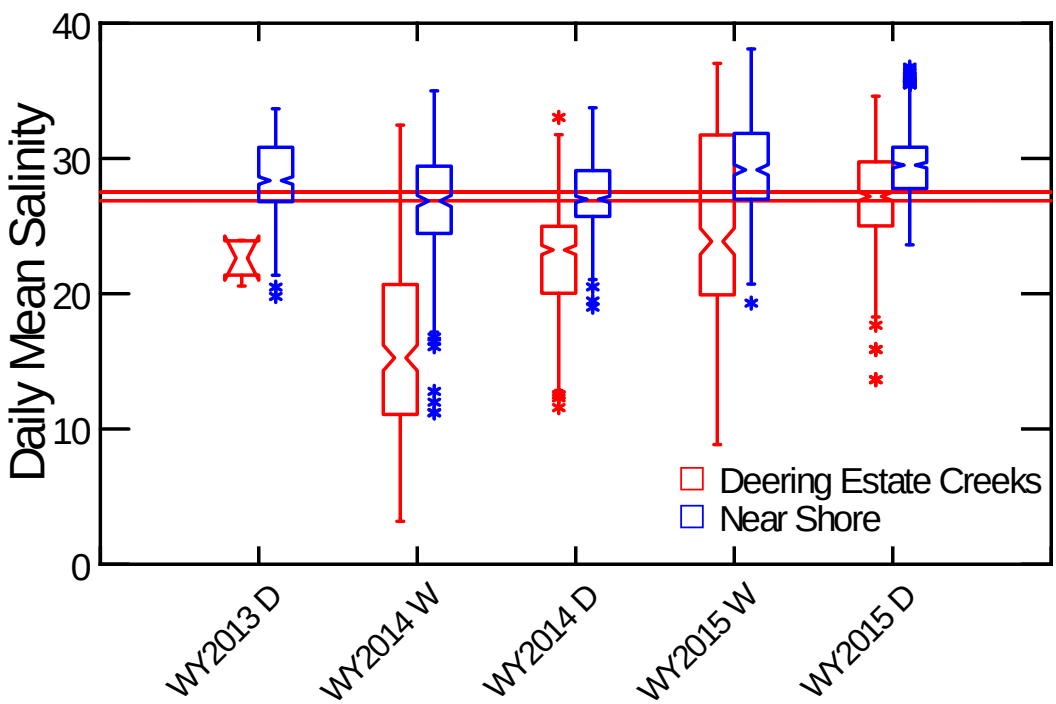


Figure 43. Daily mean salinity in Deering Estate creeks and nearshore areas from November 1, 2012, to April 30, 2015, by season and water year. [Note: Dry season is November–April and wet season is May–October. A description of box plots is provided in Figure 8.]

Figure 44 represents total freshwater discharge at S-700 and S-123 as well as total rainfall at S-123 by season and water year. The high median salinity value during the WY2015 dry season could be linked to the low freshwater discharge and the low rainfall during this interval. Nevertheless, other factors not analyzed in the current report might play a role in high salinity values since the freshwater discharge and rainfall are the second lowest during the WY2015 dry season, while the lowest values have been registered during the WY2013 dry season.

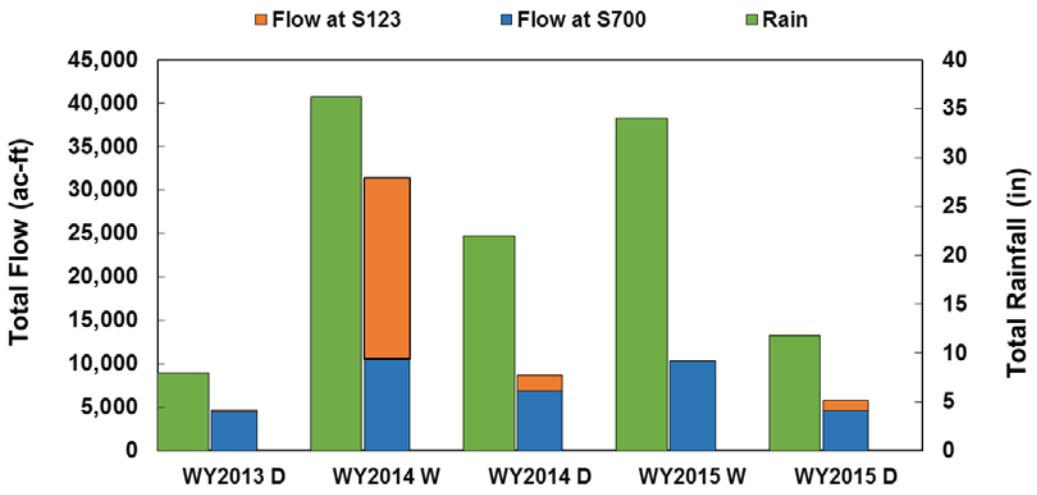


Figure 44. Total flow and rainfall at stations S-700 and S-123 from November 1, 2012, to April 30, 2015, by season and water year. [Note: Dry season is November–April and wet season is May–October.]

Vegetation Changes

Vegetation in the southern part of Cutler Creek already appears to be responding to the changed hydrology. As expected, there has been a change in the composition of the vegetative community within the affected area of rehydration downstream of S-700. Some species appear to be dying quickly, like trema (*Trema* spp.), mastic (*Pistacia lentiscus*), and lancewood (*Oxandra lanceolata*), and others will be in a weakened state and susceptible to pathogens (**Figure 45**).

Figure 45. Changes in vegetation communities near the Deering Estate Flow-way.

HERBICIDE AND PESTICIDE TRACKING

L-31E CULVERTS

Exotic plant infestations within the project area along the L-31E Culverts exist primarily as scattered plants that have regrown from the residual seed bank. A small crew spent one day treating approximately ten acres of Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*) within the mangroves. Most plants were small and were hand pulled. A total of 0.13 ounces of Garlon 3A (triclopyr) at 50 percent strength was used to chemically treat larger trees. Beach naupaka (*Scaevola taccada*) and latherleaf (*Colubrina asiatica*) were treated along the levee toe/mangrove edge.

DEERING ESTATES

Exotic plant species within the Deering Estate historic wetland in the vicinity of Cutler Creek were treated chemically (herbicides) and mechanically. During the reporting period, exotic vegetation within approximately 31 acres in the vicinity of Cutler Creek were treated with herbicides, 5 gallons of Garlon 3-A. The dominant exotic species removed or treated were jasmine (*Jasmine spp.*), air potato (*Dioscorea bulbifera*), Brazilian pepper (*Schinus terebinthifolius*), sansevieria (*Sansevieria hyacinthoides*), pothos (*Epipremnum pinnatum*), bamboo (*Bambusia spp.*), cattail (*Typha latifolia*), syngonium (*Syngonium podophyllum*), shoebutton ardisia (*Ardisia elliptica*), and rattlebox (*Crotalaria spp.*).

LITERATURE CITED

FDEP. 2013. Technical Support Document: Derivation of Dissolved Oxygen Criteria to Protect Aquatic Life in Florida's Fresh and Marine Waters. DEP-SAS-001/13. Florida Department of Environmental Protection, Tallahassee, FL.

FDEP. 2014. FT 1000: General Field Testing and Measurement. DEP-SOP-001/01. Florida Department of Environmental Protection, Tallahassee, FL.

FDEP and SFWMD. 2011. A Protocol for Monitoring Mercury and Other Toxicants. Florida Department of Environmental Protection, Tallahasee, FL, and South Florida Water Management District, West Palm Beach, FL.

Miami-Dade DERM. 2010. Quality Assurance Project Plan: Biscayne Bay Surface Water Quality and Biological Monitoring Program, Agreement No. 4600001822. Miami-Dade Department of Environmental Resources Management, Miami, FL.

SFWMD. 2014. Interim 2014 Project Operating Manual for the Deering Estate Flow-way Component of the Biscayne Bay Coastal Wetlands Project. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2015. Field Sampling Quality Manual. SFWMD-FIELD-QM-001-08.2. South Florida Water Management District, West Palm Beach, FL. Effective January 15, 2015.

USACE and SFWMD. 2012. Central and Southern Florida Project Comprehensive Everglades Restoration Plan Biscayne Bay Coastal Wetlands Phase I Final Integrated Project Implementation Report and Environmental Impact Statement. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Biscayne Bay Coastal Wetlands project (CERPRA permit 0271729-007).

Specific Condition	Description	Applicable Phase	Action Taken	Included in This Report as:			
				Narrative (page #s)	Figure	Table	Attachment
5	L-31E Culverts Pilot Pump Test Project	Operations	Done as required				
15	Manatee Protection During Construction	Construction	Done as required				
16	Operation of Passive Structures	Operation	Operation of passive structures was conducted as required	24-32	15–21	6-7	C,G,H
17	Pump Station Operation	Operation	Done as required	33-35	22-25		C
18	L-31E Culverts Pilot Pump Test	Operations & Maintenance	Done as required				
19	Pump Station Testing and Maintenance	Operation	Done as required				
20	Inspection and Maintenance	Operation	Done as required				
21	Public Health, Safety, and Welfare	Operation	Discharges did not pose serious danger to public health/safety/welfare				
22	Monitoring Program	Operation	Monitoring program conducted as required				B,D,E,F
22A	Quality Assurance and Quality Control	Operation	Done as required				B,D,E,F
22B	Method Detection Limits	Operation	Done as required				B,D,E,F
23	Turbidity Monitoring	Construction	No action needed				
24	Mercury & Other Toxicants	Operation	Monitoring plan completed and submitted, and baseline data collected and evaluated, as required	24-24		4-5	B
25	Removal of Parameters	Operation	No action needed				
26	Addition of Parameters	Operation	No action needed				
27	Construction Status Reports	Construction	No action needed				
28	Annual Reports	Operation	Annual report completed and submitted as required	All	All	All	All
28A	Water Quality Data	Operation	Records include all required details	11–22	5–14	3	A,B,D,E,F
28B	Performance Evaluation	Operation	Annual performance evaluated and reported as required	All	All	All	All
28C	Herbicide and Pesticide Tracking	Operation	Herbicide and pesticide use tracked and reported as required.	58			
28D	Implementation Schedules	All	No action needed				
29	L-31E Culverts Pilot Pump Test	Operations	Performance will be evaluated and reported in an after action assessment which is planned to be submitted in July 2015	3			
30	Permit Modifications	Operation	Mod 0271729-007 issued July 18, 2014, for L-31E Pilot Pump Test	10		2	
31	Permit Renewal	Operation	No action needed	10		2	
32	Department Review and Approval	Operation	No action needed	11			

Attachment B: Water Quality Data

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007), and is available upon request.

Attachment C: Hydrologic Data

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007), and is available upon request.

Attachment D: Summary of Water Quality at BB53, MI01, MW01, and PR01 during WY2015 and Comparisons with Class III Standards for Marine Waters

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007).

Table D-1. Summary of in situ (field measured) water quality parameters measured at BB53, MI01, MW01, and PR01 during WY2015 and comparisons with Class III standards for marine waters. Note: Since 10/1/2014, monitoring has been conducted at a single depth. These results were included in the calculation of "S" (surface) values below.

Parameter	Relative Depth[1]	Units[2]	Class III Standard for Marine Waters	Samples	Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Excursions	Percent Excursions
STATION: BB53													
Dissolved Oxygen	S	mg/L		10	7.4	1.2	5.4	6.5	7.7	8.4	8.8	NA	NA
	M			2	5.3	0.2	5.1	5.1	5.3	5.5	5.5	NA	NA
	B			4	6.3	1.1	5.3	5.5	6.1	7.1	7.9	NA	NA
Percent Dissolved Oxygen Saturation	S	%	%DO saturation should not be under 42% limit more than 10% of the time	10	NA	NA	76%	89%	103%	108%	124%	0	0%
	M			2			76%	76%	81%	86%	86%	0	0%
	B			4			77%	80%	89%	110%	125%	0	0%
(Field) pH	S		6.5 ≤ pH ≤ 8.5	8	NA	NA	7.80	8.00	8.10	8.15	8.40	0	0%
	M			1			8.00				8.00	0	0%
	B			2			8.03	8.03	8.05	8.06	8.06	0	0%
Salinity	S			10	23.6	10.0	4.3	19.7	23.3	28.4	42.9	NA	NA
	M			2	34.0	12.5	25.1	25.1	34.0	42.9	42.9	NA	NA
	B			4	25.1	15.4	5.6	14.5	25.9	35.6	42.9	NA	NA
Specific Conductance	S	µS/cm		10	36,567	14,344	7,809	31,634	36,496	44,225	63,511	NA	NA
	M			2	51,549	16,930	39,578	39,578	51,549	63,520	63,520	NA	NA
	B			4	38,737	22,136	10,028	23,607	40,711	53,868	63,500	NA	NA
STATION: MI01													
Dissolved Oxygen	S	mg/L		19	6.3	1.4	3.4	5.3	6.4	7.6	8.0	NA	NA
	M			5	4.7	1.0	3.5	4.0	4.4	5.2	6.3	NA	NA
	B			5	4.6	1.4	2.7	3.4	4.7	5.8	6.2	NA	NA
Percent Dissolved Oxygen Saturation	S	%	%DO saturation should not be under 42% limit more than 10% of the time	19	NA	NA	55%	74%	87%	97%	107%	0	0%
	M			5			56%	63%	66%	77%	95%	0	0%
	B			5			42%	53%	72%	90%	100%	0	0%
(Field) pH	S		6.5 ≤ pH ≤ 8.5	17	7.81	0.27	7.10	7.68	7.90	8.00	8.22	0	0%
	M			3	7.99	0.23	7.77	7.82	7.97	8.17	8.23	0	0%
	B			3	8.04	0.14	7.90	7.94	8.04	8.15	8.18	0	0%
Salinity	S			17	22.7	8.6	5.0	20.2	22.5	23.4	41.9	NA	NA
	M			5	28.3	11.0	18.8	19.7	22.3	39.3	41.9	NA	NA
	B			5	33.0	7.6	25.0	27.3	30.4	39.9	42.9	NA	NA
Specific Conductance	S	µS/cm		19	33,251	14,121	4,430	28,371	34,900	36,618	62,259	NA	NA
	M			5	43,676	15,087	30,510	31,885	35,543	58,866	62,244	NA	NA
	B			5	50,386	10,173	39,405	42,572	47,039	59,600	63,588	NA	NA

Table D-1. Continued

Parameter	Relative Depth[1]	Units[2]	Class III Standard for Marine Waters	Samples	Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Excursions	Percent Excursions
STATION: MW01													
Dissolved Oxygen	S	mg/L		19	6.2	1.7	4.0	4.5	6.3	7.4	9.2	NA	NA
	M			5	4.0	0.1	3.8	3.9	4.0	4.1	4.1	NA	NA
	B			5	3.8	0.4	3.2	3.5	3.6	4.1	4.4	NA	NA
Percent Dissolved Oxygen Saturation	S	%	%DO saturation should not be under 42% limit more than 10% of the time	19	NA	NA	52%	66%	82%	96%	122%	0	0%
	M			5			51%	56%	61%	64%	65%	0	0%
	B			5			51%	55%	58%	65%	71%	0	0%
(Field) pH	S		6.5 ≤ pH ≤ 8.5	17	7.87	0.27	7.39	7.68	8.00	8.00	8.42	0	0%
	M			3	7.92	0.48	7.45	7.56	7.90	8.28	8.40	0	0%
	B			3	8.03	0.24	7.84	7.87	7.95	8.21	8.30	0	0%
Salinity	S			17	23.9	9.8	6.0	14.9	24.2	28.2	42.6	NA	NA
	M			5	27.7	14.9	9.3	13.5	31.5	40.7	42.6	NA	NA
	B			5	37.7	4.9	31.9	33.1	38.7	41.4	43.8	NA	NA
Specific Conductance	S	µS/cm		19	34,317	15,923	6,191	23,711	36,312	43,158	63,187	NA	NA
	M			5	42,417	21,134	15,960	22,461	48,517	60,674	63,122	NA	NA
	B			5	56,759	6,486	49,102	50,712	58,170	61,627	64,659	NA	NA
STATION: PR01													
Dissolved Oxygen	S	mg/L		10	6.3	1.3	3.9	5.5	6.3	7.6	7.8	NA	NA
	M			4	5.2	1.1	4.2	4.5	4.9	5.8	6.7	NA	NA
	B			4	5.3	1.4	3.6	4.2	5.5	6.5	6.8	NA	NA
Percent Dissolved Oxygen Saturation	S	%	%DO saturation should not be under 42% limit more than 10% of the time	10	NA	NA	59%	78%	83%	95%	98%	0	0%
	M			4			63%	64%	67%	86%	105%	0	0%
	B			4			56%	64%	82%	100%	108%	0	0%
(Field) pH	S		6.5 ≤ pH ≤ 8.5	8	7.88	0.23	7.50	7.74	7.90	8.10	8.10	0	0%
	M			2	7.85	0.06	7.80	7.80	7.85	7.89	7.89	0	0%
	B			2	8.00	0.04	7.97	7.97	8.00	8.03	8.03	0	0%
Salinity	S			10	17.1	12.1	1.8	7.3	17.9	24.3	41.0	NA	NA
	M			4	20.0	16.9	4.7	6.5	17.1	33.5	41.2	NA	NA
	B			4	29.9	9.0	21.7	23.8	27.6	36.0	42.6	NA	NA
Specific Conductance	S	µS/cm		10	27,133	17,834	3,425	12,772	28,940	38,310	61,130	NA	NA
	M			4	31,231	24,440	8,496	11,498	27,532	50,965	61,365	NA	NA
	B			4	46,014	12,243	34,642	37,645	43,164	54,383	63,085	NA	NA

1. Relative Depth Key: S – surface; M – middle; B – bottom.
2. Units Key: °C – degrees Celsius; µS/cm – microsiemens per centimeter; and mg/L – milligrams per liter.
NA – not applicable.

Table D-2. Summary of laboratory analyzed water quality parameters monitored in WY2015. (Samples were collected at approximately 0.5 meter depth.)

Parameter	Units[a]	Lab Method[b]	Class III Standard for Marine Waters	Samples	Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Samples Below Detection Limit	Excursions[c]	Percent Excursions[c]
STATION: BB53														
Color	PCU	EPA 110.2, SM2120B, SM2120C	NONE	11	11	10	1	1	8	18	28	3	NA	NA
Dissolved Ammonia	mg/L	EPA 350.1, SM4500NH3H	NONE	11	0.11	0.06	0.04	0.08	0.09	0.13	0.26	0	NA	NA
Nitrate Plus Nitrite	mg/L	EPA 353.2, SM4500NH3H/NO3F	NONE	11	0.378	0.362	0.01	0.07	0.27	0.61	1.047	2	NA	NA
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, SM4500NORGD	NONE	11	0.6	0.1	0.5	0.5	0.6	0.6	0.9	0	NA	NA
Total Phosphorus	mg/L	EPA 365.1, SM4500PF	NONE	9	0.006	0.002	0.003	0.01	0.006	0.01	0.009	3	NA	NA
Total Suspended Solids	mg/L	EPA 160.2, SM2540D	NONE	10	13.8	17.9	3	3	3	24	47	6	NA	NA
Turbidity	NTU	EPA 180.1, SM2130B	<=29 NTU	4	0.6	0.1	0.5	0.6	0.6	0.7	0.7	0	0	0%
STATION: MI01														
Color	PCU	EPA 110.2, SM2120B, SM2120C	NONE	14	13	9	3	7	9	22	30	0	NA	NA
Dissolved Ammonia	mg/L	EPA 350.1, SM4500NH3H	NONE	19	0.09	0.05	0.02	0.04	0.09	0.12	0.16	0	NA	NA
Nitrate Plus Nitrite	mg/L	EPA 353.2, SM4500NH3H/NO3F	NONE	19	0.198	0.221	0.01	0.04	0.14	0.26	0.825	2	NA	NA
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, SM4500NORGD	NONE	17	0.5	0.1	0.3	0.5	0.6	0.6	0.7	0	NA	NA
Total Phosphorus	mg/L	EPA 365.1, SM4500PF	NONE	13	0.009	0.004	0.004	0.01	0.007	0.01	0.019	0	NA	NA
Total Suspended Solids	mg/L	EPA 160.2, SM2540D	NONE	11	14.4	17.9	3	3	3	27	57	7	NA	NA
Turbidity	NTU	EPA 180.1, SM2130B	<=29 NTU	19	1.3	0.6	0.5	0.6	1.3	1.8	2.4	0	0	0%

Table D-2. Continued.

Parameter	Units[a]	Lab Method[b]	Class III Standard for Marine Waters	Samples	Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Samples Below Detection Limit	Excursions[c]	Percent Excursions[c]
STATION: MW01														
Color	PCU	EPA 110.2, SM2120B, SM2120C	NONE	14	9	9	1	1	5	18	25	3	NA	NA
Dissolved Ammonia	mg/L	EPA 350.1, SM4500NH3H	NONE	19	0.07	0.03	0.03	0.04	0.07	0.09	0.13	0	NA	NA
Nitrate Plus Nitrite	mg/L	EPA 353.2, SM4500NH3H/NO3F	NONE	19	0.353	0.345	0.01	0.06	0.231	0.54	1.226	2	NA	NA
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, SM4500NORGD	NONE	17	0.4	0.1	0.3	0.4	0.4	0.5	0.6	0	NA	NA
Total Phosphorus	mg/L	EPA 365.1, SM4500PF	NONE	12	0.008	0.003	0.005	0.01	0.008	0.01	0.015	0	NA	NA
Total Suspended Solids	mg/L	EPA 160.2, SM2540D	NONE	11	13.3	16.5	3	3	4	18.5	49	5	NA	NA
Turbidity	NTU	EPA 180.1, SM2130B	<=29 NTU	19	1.1	0.3	0.5	0.8	1.1	1.2	1.7	0	0	0%
STATION: PR01														
Color	PCU	EPA 110.2, SM2120B, SM2120C	NONE	11	10	8	2	4	7	14	25	0	NA	NA
Dissolved Ammonia	mg/L	EPA 350.1, SM4500NH3H	NONE	11	0.13	0.08	0.02	0.08	0.13	0.18	0.28	0	NA	NA
Nitrate Plus Nitrite	mg/L	EPA 353.2, SM4500NH3H/NO3F	NONE	11	1.293	1.002	0.01	0.71	1.065	1.96	3.34	0	NA	NA
Total Kjeldahl Nitrogen	mg/L	EPA 351.2, SM4500NORGD	NONE	9	0.5	0.1	0.2	0.5	0.6	0.6	0.7	0	NA	NA
Total Phosphorus	mg/L	EPA 365.1, SM4500PF	NONE	7	0.008	0.003	0.004	0.01	0.008	0.01	0.012	0	NA	NA
Total Suspended Solids	mg/L	EPA 160.2, SM2540D	NONE	11	11	13.5	3	3	3	14	40	6	NA	NA
Turbidity	NTU	EPA 180.1, SM2130B	<=29 NTU	4	0.8	0.1	0.7	0.7	0.8	0.9	1	0	0	0%

a. Key to Units: mg/L – milligram per liter; NTU – nephelometric turbidity units; and PCU – photo conductor units.
b. EPA – United States Environmental Protection Agency and SM – Standard Method.
c. Not applicable

Table D-3. Comparison of in situ (field measured) water quality parameters by station from the baseline period through WY2015. [Note: p-values below 0.05 are shown in red, bold, underlined font. NA – not applicable. Since 10/1/2014, monitoring was only conducted at a single depth. These results were included in the calculation of "S" (surface) values below.]

Parameter	Relative Depth	Period	Number of Samples				Mean				Median			
			BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01
Dissolved Oxygen (mg/L)	Surface	Baseline	9	9	9	8	7.4	5.5	5.6	5.9	7.6	5.8	6.8	6.5
		WY2011	10	10	10	10	7.8	6	6.1	5.6	7.6	5.8	5.8	5.5
		WY2012	12	12	12	12	6.8	5.8	5.3	4.9	7.9	6	5.7	5
		WY2013	9	11	11	11	7.8	6	6.1	5.6	7.1	6	5.5	5.4
		WY2014	10	11	11	10	7.2	5.5	5.3	5.2	7.7	5.6	5.3	5
		WY2015	10	19	19	10	7.4	6.3	6.2	6.3	7.7	6.4	6.3	6.3
		ANOVA and Kruskal Wallis p-Value					0.725	0.782	0.593	0.294	0.928	0.733	0.717	0.31
	Middle	Baseline	7	9	9	8	7.6	5.1	5.5	6.1	7.6	6	5.2	5.6
		WY2011	8	10	10	10	8.1	5.7	5.7	5.5	7.7	5.6	5.4	5.1
		WY2012	9	12	12	12	6.5	5.5	5.1	5	7.6	6.2	5.5	5.2
		WY2013	7	11	11	11	7.6	6	6.1	5.6	7.1	5.7	5.7	5.5
		WY2014	6	10	11	10	7	5	5.3	5.6	6.6	5	5	6
		WY2015	2	5	5	4	5.3	4.7	4	5.2	5.3	4.4	4	4.9
		ANOVA and Kruskal Wallis p-Value					0.36	0.669	0.297	0.665	0.366	0.547	0.147	0.831
	Bottom	Baseline	9	9	9	8	7.7	5.7	5.1	6	7.9	6.3	5.3	5.1
		WY2011	9	10	10	10	7.7	6.1	5.4	5.4	7.4	6.3	5.8	4.8
		WY2012	12	12	12	12	6.4	4.9	5.2	5.3	6.5	4.8	5.3	5.8
		WY2013	9	11	11	11	6.2	5.7	5.6	6	6.5	5.4	5.3	6.1
		WY2014	10	11	11	10	6.6	5.4	4.9	5.5	6.1	5.9	5.1	5
		WY2015	4	5	5	4	6.3	4.6	3.8	5.3	6.1	4.7	3.6	5.5
		ANOVA and Kruskal Wallis p-Value					0.333	0.68	0.651	0.896	0.528	0.597	0.609	0.94

Table D-3. Continued.

Parameter	Relative Depth	Period	Number of Samples				Mean				Median			
			BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01
Percent Dissolved Oxygen Saturation (%)	Surface	Baseline	9	9	9	8	NA	NA	NA	NA	100%	71%	77%	76%
		WY2011	10	10	10	10	NA	NA	NA	NA	101%	80%	87%	73%
		WY2012	12	12	12	12	NA	NA	NA	NA	106%	85%	79%	69%
		WY2013	9	11	11	11	NA	NA	NA	NA	99%	82%	75%	69%
		WY2014	10	11	11	10	NA	NA	NA	NA	106%	78%	72%	68%
		WY2015	9	19	19	10	NA	NA	NA	NA	105%	87%	86%	83%
		Kruskal Wallis p-Value					NA	NA	NA	NA	0.972	0.499	0.626	0.289
	Middle	Baseline	7	9	9	8	NA	NA	NA	NA	106%	74%	68%	70%
		WY2011	8	10	10	9	NA	NA	NA	NA	101%	76%	80%	68%
		WY2012	9	12	12	12	NA	NA	NA	NA	103%	91%	78%	69%
		WY2013	7	11	11	11	NA	NA	NA	NA	99%	74%	77%	71%
		WY2014	6	10	11	10	NA	NA	NA	NA	94%	74%	75%	81%
		WY2015	1	5	5	4	NA	NA	NA	NA	76%	66%	61%	67%
		Kruskal Wallis p-Value					NA	NA	NA	NA	0.576	0.564	0.317	0.998
	Bottom	Baseline	9	9	9	8	NA	NA	NA	NA	109%	88%	70%	68%
		WY2011	9	10	10	9	NA	NA	NA	NA	104%	87%	78%	70%
		WY2012	12	12	12	12	NA	NA	NA	NA	94%	74%	82%	83%
		WY2013	9	11	11	11	NA	NA	NA	NA	93%	75%	79%	86%
		WY2014	10	11	11	10	NA	NA	NA	NA	86%	78%	70%	66%
		WY2015	4	5	5	4	NA	NA	NA	NA	89%	72%	58%	82%
		Kruskal Wallis p-Value					NA	NA	NA	NA	0.655	0.926	0.68	0.979
pH	Surface	Baseline	9	9	9	8	NA	NA	NA	NA	7.99	7.63	7.71	7.65
		WY2011	10	10	10	10	NA	NA	NA	NA	8.07	7.8	7.86	7.59
		WY2012	12	12	12	12	NA	NA	NA	NA	8.13	8.01	8	7.7
		WY2013	10	12	12	12	NA	NA	NA	NA	8.04	7.68	7.71	7.49
		WY2014	10	11	11	10	NA	NA	NA	NA	8.06	7.87	7.73	7.67
		WY2015	8	17	17	8	NA	NA	NA	NA	8.1	7.9	8	7.9
		ANOVA and Kruskal Wallis p-Value					NA	NA	NA	NA	0.99	**0.021**	0.344	0.067
	Middle	Baseline	7	9	9	8	NA	NA	NA	NA	7.98	7.65	7.73	7.63
		WY2011	8	10	10	10	NA	NA	NA	NA	8.05	7.79	7.97	7.67
		WY2012	9	12	12	12	NA	NA	NA	NA	8.11	8.08	8.02	7.89
		WY2013	8	12	12	12	NA	NA	NA	NA	8.06	7.75	7.79	7.62
		WY2014	6	10	11	10	NA	NA	NA	NA	8.03	7.89	7.78	7.8
		WY2015	1	3	3	2	NA	NA	NA	NA	8	7.97	7.9	7.85
		ANOVA and Kruskal Wallis p-Value					NA	NA	NA	NA	0.986	**0.007**	0.467	0.215
	Bottom	Baseline	9	9	9	8	NA	NA	NA	NA	8	7.86	7.99	7.92
		WY2011	9	10	10	10	NA	NA	NA	NA	8.05	7.85	7.93	7.92
		WY2012	12	12	12	12	NA	NA	NA	NA	8.05	7.88	8.1	7.94
		WY2013	10	12	12	12	NA	NA	NA	NA	7.98	7.84	7.92	7.88
		WY2014	10	11	11	10	NA	NA	NA	NA	8.05	8.02	7.98	7.96
		WY2015	2	3	3	2	NA	NA	NA	NA	8.05	8.04	7.95	8
		ANOVA and Kruskal Wallis p-Value					NA	NA	NA	NA	0.857	0.558	0.518	0.907

Table D-3. Continued.

Parameter	Relative Depth	Period	Number of Samples				Mean				Median			
			BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01
Salinity	Surface	Baseline	9	9	9	8	21.6	15.4	16.3	9.5	21.7	18.8	13.2	8.4
		WY2011	10	10	10	10	21.1	15	18.1	11.3	24.3	16	18.8	8.5
		WY2012	12	12	12	12	23.6	17.8	22.6	15.6	21.5	12.5	21.9	9.8
		WY2013	10	12	12	12	15.2	12.1	10.3	5.3	13.1	7.5	9.5	2.7
		WY2014	11	12	12	11	17.4	17.5	13.6	6.5	19.5	21	12.8	5.9
		WY2015	10	17	17	10	23.6	22.7	23.9	17.1	23.3	22.5	24.2	17.9
		ANOVA and Kruskal Wallis p-Value					0.088	0.101	**0.005**	**0.03**	0.077	0.163	**0.009**	**0.03**
	Middle	Baseline	7	9	9	8	20.8	15.7	16	8.1	21.8	18.8	13.7	6
		WY2011	8	10	10	10	20.3	16.9	20.8	15.1	21.8	18.1	25.7	16.2
		WY2012	9	12	12	12	22.7	20.2	23.4	17.4	20.4	18.1	22.8	16.9
		WY2013	8	12	12	12	18	13.1	13.4	7	17.6	10.3	14.1	3.1
		WY2014	7	11	12	11	19.8	19.9	14.2	10.7	21.5	22.2	14.2	10.4
		WY2015	2	5	5	4	34	28.3	27.7	20	34	22.3	31.5	17.1
		ANOVA and Kruskal Wallis p-Value					0.21	0.089	0.052	0.088	0.476	0.294	0.126	0.11
	Bottom	Baseline	9	9	9	8	21.3	20.9	24.2	16.7	20.8	22	26.3	19.3
		WY2011	9	10	10	10	20.9	21.8	23.6	20.3	25.6	23.3	28.1	22
		WY2012	12	12	12	12	24.4	26	27.5	24.3	21.5	23.3	25.2	22.6
		WY2013	10	12	12	12	16.8	18.4	23.2	15.2	15	18.6	21.9	15.2
		WY2014	11	12	12	11	19.3	21.5	22.8	17.7	21.6	23.4	23.5	19.7
		WY2015	4	5	5	4	25.1	33	37.7	29.9	25.9	30.4	38.7	27.6
		ANOVA and Kruskal Wallis p-Value					0.32	**0.01**	**0.01**	**0.02**	0.425	**0.042**	**0.027**	**0.039**
Specific Conductance (µS/cm)	Surface	Baseline	9	9	9	8	34,349	24,879	26,379	15,916	34,476	30,260	22,053	14,496
		WY2011	10	10	10	10	33,338	24,372	28,362	18,435	38,270	26,074	29,640	14,748
		WY2012	12	12	12	12	37,118	28,209	35,305	24,809	34,240	20,943	34,826	16,739
		WY2013	10	12	12	12	24,884	19,304	17,278	8,906	21,830	12,754	16,188	5,039
		WY2014	11	12	12	11	28,112	28,037	21,200	11,153	31,389	33,632	21,446	10,448
		WY2015	10	19	19	10	36,567	33,251	34,317	27,133	36,496	34,900	36,312	28,940
		ANOVA and Kruskal Wallis p-Value					0.098	0.229	**0.015**	**0.028**	0.075	0.352	**0.027**	**0.029**
	Middle	Baseline	7	9	9	8	33,298	25,438	25,965	13,661	34,554	30,239	22,861	10,534
		WY2011	8	10	10	10	32,141	27,274	32,572	24,369	34,520	29,192	40,194	26,615
		WY2012	9	12	12	12	35,842	31,865	36,455	27,555	32,632	29,558	36,013	27,476
		WY2013	8	12	12	12	29,081	20,897	21,952	11,514	28,517	17,296	23,290	5,718
		WY2014	7	11	12	11	31,741	31,647	23,541	17,525	34,207	35,446	23,461	17,578
		WY2015	2	5	5	4	51,549	43,676	42,417	31,231	51,549	35,543	48,517	27,532
		ANOVA and Kruskal Wallis p-Value					0.235	0.086	0.072	0.085	0.479	0.29	0.145	0.111
	Bottom	Baseline	9	9	9	8	34,002	33,327	38,084	27,065	33,212	34,992	41,105	30,953
		WY2011	9	10	10	10	33,088	34,488	36,693	32,074	40,346	36,714	43,426	34,935
		WY2012	12	12	12	12	38,238	40,424	42,554	38,194	34,207	36,744	39,499	35,844
		WY2013	10	12	12	12	27,168	29,412	36,518	24,522	24,721	30,405	34,984	24,983
		WY2014	11	12	12	11	30,903	34,225	36,436	28,458	34,613	37,030	39,451	31,645
		WY2015	4	5	5	4	38,737	50,386	56,759	46,014	40,711	47,039	58,170	43,164
		ANOVA and Kruskal Wallis p-Value					0.339	**0.011**	**0.015**	**0.024**	0.431	**0.043**	**0.028**	**0.036**

Table D-4. Comparison of laboratory analyzed water quality parameters by station. [Note: p-values below 0.05 are shown in red, underlined font]

Parameter	Period	Number of Samples				Mean				Median			
		BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01	BB53	MI01	MW01	PR01
Color	Baseline	9				18				20			
	WY2011	9				16				15			
	WY2012	12	11	11	11	17	25	24	16	18	25	25	18
	WY2013	10	11	12	12	21	21	17	14	21	22	18	13
	WY2014	11	12	12	11	20	21	15	18	22	20	15	20
	WY2015	11	14	14	11	11	13	9	10	8	9	5	7
	ANOVA and Kruskal Wallis p-Value					**0.01**	**<0.001**	**<0.001**	**0.036**	**0.029**	**0.05**	**0.002**	**0.05**
Dissolved Ammonia (mg/L)	Baseline	10	10	10	9	0.1	0.11	0.06	0.11	0.08	0.12	0.06	0.07
	WY2011	8	9	9	8	0.12	0.11	0.08	0.15	0.09	0.1	0.09	0.16
	WY2012	12	12	12	12	0.1	0.1	0.09	0.13	0.08	0.11	0.08	0.12
	WY2013	9	12	12	12	0.07	0.1	0.06	0.09	0.07	0.09	0.06	0.08
	WY2014	11	12	12	11	0.09	0.08	0.06	0.12	0.09	0.09	0.07	0.09
	WY2015	11	19	19	11	0.11	0.09	0.07	0.13	0.09	0.09	0.07	0.13
	ANOVA and Kruskal Wallis p-Value					0.562	0.44	0.143	0.562	0.423	0.442	0.177	0.29
Nitrite + Nitrate	Baseline	10	10	10	9	0.357	0.51	0.613	2.423	0.275	0.33	0.75	2.19
	WY2011	9	9	9	9	0.483	0.317	0.544	1.401	0.3	0.29	0.28	0.91
	WY2012	12	12	12	12	0.294	0.314	0.308	1.638	0.145	0.29	0.175	1.435
	WY2013	9	12	12	12	0.49	0.483	0.664	2.684	0.25	0.635	0.645	3.075
	WY2014	10	12	11	11	0.408	0.238	0.765	1.039	0.295	0.17	0.57	0.87
	WY2015	11	19	19	11	0.378	0.198	0.353	1.293	0.27	0.14	0.231	1.065
	ANOVA and Kruskal Wallis p-Value					0.864	**0.04**	**0.05**	**0.022**	0.72	0.084	**0.027**	0.087
Total Kjeldahl Nitrogen (mg/L)	Baseline	10	5	5	4	0.4	0.4	0.2	0.5	0.4	0.3	0.2	0.6
	WY2011	9	4	4	4	0.4	0.5	0.2	0.4	0.4	0.6	0.2	0.4
	WY2012	11	5	5	5	0.4	0.3	0.3	0.3	0.5	0.5	0.3	0.3
	WY2013	10	6	5	6	0.4	0.3	0.2	0.4	0.2	0.3	0.1	0.2
	WY2014	11	5	6	6	0.5	0.4	0.3	0.5	0.5	0.4	0.3	0.5
	WY2015	11	17	17	9	0.6	0.5	0.4	0.5	0.6	0.6	0.4	0.6
	ANOVA and Kruskal Wallis p-Value					0.212	**0.036**	**0.007**	0.784	0.052	0.086	**0.024**	0.149
Total Phosphorus (mg/L)	Baseline	10	10	9	9	0.003	0.006	0.006	0.005	0.003	0.006	0.005	0.005
	WY2011	9	8	5	9	0.004	0.008	0.007	0.007	0.004	0.008	0.007	0.008
	WY2012	12	12	10	12	0.006	0.007	0.007	0.008	0.005	0.007	0.007	0.008
	WY2013	10	12	9	11	0.005	0.008	0.006	0.007	0.005	0.007	0.006	0.006
	WY2014	11	9	8	11	0.005	0.006	0.005	0.005	0.005	0.006	0.005	0.005
	WY2015	9	13	12	7	0.006	0.009	0.008	0.008	0.006	0.007	0.008	0.008
	ANOVA and Kruskal Wallis p-Value					**0.001**	0.078	**0.012**	**0.002**	**0.012**	0.282	**<0.001**	**0.02**
Total Suspended Solids (mg/L)	Baseline	1	1	1	1	85	56	44	6	85	56	44	6
	WY2011												
	WY2012	11	10	10	10	59.4	37.2	48	34.4	52	35.5	52.5	36
	WY2013	10	12	12	12	37.1	31.6	28.1	17.3	35.5	27	28	9
	WY2014	10	12	12	11	48.3	44	30.8	23.1	50	48.5	28	26
	WY2015	10	11	11	11	13.8	14.4	13.3	11	3	3	4	3
	ANOVA and Kruskal Wallis p-Value					**<0.001**	**0.011**	**0.003**	0.081	**<0.001**	**0.007**	**0.002**	**0.014**
Turbidity	Baseline	10	10	10	9	0.6	1.1	0.9	1	0.7	0.8	0.7	1.1
	WY2011	7	7	7	7	0.9	0.9	0.8	1.1	0.8	0.9	0.6	1.1
	WY2012	12	12	12	12	0.9	0.9	0.7	0.9	0.9	0.9	0.6	0.9
	WY2013	10	12	12	12	0.8	0.6	0.6	0.8	0.8	0.6	0.6	1
	WY2014	10	11	11	10	0.7	0.7	0.5	1	0.7	0.6	0.5	1.1
	WY2015	4	19	19	4	0.6	1.3	1.1	0.8	0.6	1.3	1.1	0.8
	ANOVA and Kruskal Wallis p-Value					0.092	**0.001**	**<0.001**	0.433	0.21	**0.009**	**0.003**	0.259

Attachment E: Summary of Water Quality at S-700 Pump Station during WY2015 and Comparisons with Class III Freshwater Criteria

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007).

Table E-1. Basic statistics of water quality parameters at S-700 pump station for WY2015 and comparisons with Class III freshwater criteria.

Parameter	Units[a]	Lab Method[b]	Class III Criteria for Freshwater	Samples	Mean	Standard Deviation	Minimum	Q25	Median	Q75	Maximum	Number Below Detection Limit	Excursions	Percent Excursions
IN SITU (FIELD MEASURED) PARAMETERS														
Dissolved Oxygen	mg/L		%DO saturation should not be under compliance limit more than 10% of the time	23	5.5	1.2	3	4.6	5.4	6.5	8.5	NA	NA	NA
Percent Dissolved Oxygen Saturation	%			23	NA	NA	37%	57%	68%	80%	112%	NA	0	0.00%
(Field) pH			6 < pH < 8.5	23	NA	NA	7.1	7.3	7.4	7.6	8.1	NA	0	0.00%
Specific Conductance	µS/cm		< 1275 µS/cm	23	564	20	526	549	566	578	599	NA	0	0.00%
Water Temperature	˚C		None	23	26.8	2.5	22.1	24.5	28.2	29	30	NA	NA	NA
LAB ANALYZED PARAMETERS														
Dissolved Ammonia	mg/L	SM4500NH3H	None	21	0.019	0.011	0.005	0.009	0.017	0.027	0.044	1	NA	NA
Nitrate + Nitrite	mg/L	SM4500NO3F	None	23	0.161	0.118	0.005	0.092	0.121	0.194	0.513	1	NA	NA
Total Kjeldahl Nitrogen	mg/L	EPA 351.2 and SM4500NORGD	None	23	0.3	0.1	0.2	0.2	0.3	0.4	0.8	0	NA	NA
Total Phosphorus	mg/L	SM4500PF	None	19	0.014	0.003	0.007	0.013	0.014	0.016	0.022	0	NA	NA
Total Nitrogen	mg/L	SM4500NC	None	1	0.56	NA			0.56			0	NA	NA

a. Key to Units: ° C – degrees Celsius; µS/cm – microsiemens per centimeter; and mg/L – milligram per liter.
b. EPA – United States Environmental Protection Agency and SM – Standard Method.

Attachment F: Total Monthly Flow, Nitrite + Nitrate, Ammonia, Total Kjeldahl Nitrogen, Total Nitrogen, Total Organic Nitrogen, and Total Phosphorus Loads and Flow-weighted Mean Concentrations at S–700

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands Project permit (0271729-007).

Table F-1. Total monthly flow, nitrite + nitrate (NO_x), ammonia (NH_4), total Kjeldahl nitrogen (TKN), total nitrogen (TN), total organic nitrogen (TORGN), and total phosphorus (TP) loads, and flow-weighted mean concentrations (FWMCs) at S-700.[a]

Month	Season	Total Monthly Flow		NO_X		NH_4		TKN		TN		TORGN		TP	
		(cfs)	(ac-ft)	Total Monthly Load (kg)	FWMC (mg/L)	Total Monthly Load (kg)	FWMC (mg/L)	Total Monthly Load (kg)	FWMC (mg/L)	Total Monthly Load (kg)	FWMC (mg/L)	Total Monthly Load (kg)	FWMC (mg/L)	Total Monthly Load (kg)	FWMC (mg/L)
Dec-2012	Dry	232.3	460.77	95.92	0.169	16.39	0.03	144.01	0.25	239.92	0.42	127.61	0.22	7.44	0.013
Jan-2013	Dry	743.7	1475.13	287.37	0.158	144.78	0.08	970.13	0.53	1257.5	0.69	825.35	0.45	26.78	0.015
Feb-2013	Dry	782.48	1552.04	404.54	0.211	122.01	0.06	1081.22	0.56	1485.76	0.78	959.21	0.5	29.21	0.015
Mar-2013	Dry	295.28	585.68	140.04	0.194	43.77	0.06	423.15	0.59	563.18	0.78	379.37	0.53	10.2	0.014
Apr-2013	Dry	789.82	1566.61	249.96	0.129	56.12	0.03	1150.36	0.6	1400.32	0.72	1094.24	0.57	27.05	0.014
May-2013	Wet	1478.27	2932.15	249.79	0.069	72.32	0.02	1485.93	0.41	1735.72	0.48	1413.61	0.39	50.35	0.014
Jun-2013	Wet	777	1541.17	171.46	0.09	9.65	0.01	616.79	0.32	788.25	0.41	607.14	0.32	32.9	0.017
Jul-2013	Wet	1256.39	2492.05	688.42	0.224	64.21	0.02	704	0.23	1392.42	0.45	639.79	0.21	41.53	0.014
Aug-2013	Wet	1281.83	2542.51	261.5	0.083	43.66	0.01	739.29	0.24	1000.79	0.32	695.63	0.22	53.06	0.017
Sep-2013	Wet	1222.16	2424.15	257.91	0.086	74.58	0.02	796.01	0.27	1053.92	0.35	721.43	0.24	53.94	0.018
Oct-2013	Wet	796.7	1580.25	326.11	0.167	41.63	0.02	429.96	0.22	756.07	0.39	388.33	0.2	31.17	0.016
Nov-2013	Dry	652.52	1294.28	427.35	0.268	63.75	0.04	298.37	0.19	725.72	0.45	234.62	0.15	36.46	0.023
Dec-2013	Dry	620.33	1230.41	514.34	0.339	41.91	0.03	279.79	0.18	794.13	0.52	237.88	0.16	28.24	0.019
Jan-2014	Dry	603.82	1197.67	483.7	0.327	32.93	0.02	267.43	0.18	751.13	0.51	234.5	0.16	21.85	0.015
Feb-2014	Dry	516.73	1024.94	285.18	0.226	21.34	0.02	244.17	0.19	529.36	0.42	222.83	0.18	19.15	0.015
Mar-2014	Dry	581.18	1152.76	181.65	0.128	12.52	0.01	291.69	0.21	473.35	0.33	279.18	0.2	22	0.015
Apr-2014	Dry	538.66	1068.37	67.46	0.051	8.81	0.01	412.18	0.31	479.63	0.36	403.37	0.31	14.69	0.011
May-2014	Wet	74.84	148.44	6.21	0.034	0.92	0.01	48.78	0.27	54.98	0.3	47.86	0.26	1.43	0.008
Jun-2014	Wet	628.28	1246.17	154.24	0.1	8.3	0.01	381.54	0.25	535.78	0.35	373.24	0.24	23.3	0.015
Jul-2014	Wet	1212.94	2405.83	297.28	0.1	27.51	0.01	681.41	0.23	978.7	0.33	653.9	0.22	43.35	0.015
Aug-2014	Wet	1229.94	2439.54	299.12	0.099	26.14	0.01	631.21	0.21	930.32	0.31	605.07	0.2	37.84	0.013
Sep-2014	Wet	1144.36	2269.8	298.49	0.107	34.44	0.01	571.38	0.2	869.87	0.31	536.95	0.19	29.56	0.011
Oct-2014	Wet	908.14	1801.27	308.8	0.139	29.12	0.01	504.24	0.23	813.04	0.37	475.12	0.21	23.79	0.011
Nov-2014	Dry	808.63	1603.89	324.71	0.164	36.99	0.02	509.29	0.26	834	0.42	472.3	0.24	23.69	0.012
Dec-2014	Dry	514.86	1021.21	246.1	0.195	32.29	0.03	371.97	0.3	618.06	0.49	339.67	0.27	17.07	0.014
Jan-2015	Dry	635.84	1261.16	339.56	0.218	47.8	0.03	502.57	0.32	842.14	0.54	454.77	0.29	22.78	0.015
Feb-2015	Dry	309.73	614.34	169.74	0.224	24.25	0.03	250.07	0.33	419.81	0.55	225.82	0.3	10.75	0.014
Mar-2015	Dry	59.83	118.67	32.79	0.224	4.68	0.03	48.3	0.33	81.09	0.55	43.62	0.3	1.96	0.013
Apr-2015	Dry	1.9	3.77	1.04	0.224	0.15	0.03	1.54	0.33	2.58	0.55	1.39	0.3	0.06	0.012

a. Key to Units: ac-ft – acre-feet; cfs – cubic feet per second; kg – kilograms; and mg/L – milligrams per liter.

Attachment G: Monthly Discharges through BBCW L-31E Culverts during WY2015

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007).

Table G-1. Monthly average flow for the L-31E Culverts in WY2015.

Period	Month	L-31E Culverts Flow					L-31E Coastal Structures Flow			L-31E Culverts & Coastal Structures Total Flow	Available Water Diverted[a]	Percent Water Diverted[b]
		S-23A	S-23B	S-23C	S-23D	Total	S-20F	S-21A	Total			
WY2015 Wet Season	May 2014	0	0	0	21	21	0	0	0	21	1.00	100.00%
	Jun. 2014	100	185	83	170	539	13,009	5,389	18,499	19,038	0.03	3.00%
	Jul. 2014	9	98	170	320	598	24,098	10,100	34,198	34,795	0.02	2.00%
	Aug. 2014	210	378	157	365	1,111	10,789	4,651	15,440	16,552	0.07	7.00%
	Sep. 2014	114	253	523	575	1,465	7,716	7,106	14,822	16,287	0.09	9.00%
	Oct. 2014	0	4	124	230	357	14,197	9,994	23,191	23,549	0.02	2.00%
	Total (ac-ft)	433	918	1,057	1,681	4,091	69,809	37,240	106,150	110,242	0.05	5.00%
WY2015 Dry Season	Nov. 2014	0	0	516	687	1,203	12,921	6,874	19,695	20,898	0.06	6.00%
	Dec. 2014	0	0	517	702	1,228	10,262	6,087	16,309	17,537	0.07	7.00%
	Jan. 2015	0	0	196	415	612	9,972	193	9,155	9,767	0.06	6.00%
	Feb. 2015	0	0	237	467	705	6,789	533	12,102	12,806	0.06	6.00%
	Mar. 2015	0	0	91	300	391	4,088	4,349	8,437	8,828	0.04	4.00%
	Apr. 2015	0	26	0	0	26	1,683	1,631	3,314	3,339	0.01	1.00%
	Total (ac-ft)	0	26	1,557	2,571	4,165	45,715	19,667	69,012	73,175	0.05	5.00%
WY2015 Total (ac-ft)		**433**	**944**	**2,614**	**4,252**	**8,256**	**115,524**	**56,907**	**175,162**	**183,417**	**0.05**	**5.00%**

a. Available Water Diverted = Total Flow through Four L-31E Culverts / Total Flow Coastal Structures S-20F and S-21A and Four Culverts Flow.
b. Percent Water Diverted = Available Water Diverted*100.

Key to Units: ac-ft – acre-feet.

Attachment H: Monthly Water Levels Upstream, Downstream, and 100 Meters Downstream of S-23A and S-23D

This project information is required by Specific Conditions 28A and 28C of the Biscayne Bay Coastal Wetlands permit (0271729-007).

Table H-1. Monthly water levels in feet (ft) National American Vertical Datum 1988 (NAVD88) upstream and downstream of S-23A and 100 meters downstream of S-23A.

Period	Date	Stage Upstream of S-23A (ft NAVD88)	Stage Downstream of S-23A (ft NAVD88)	Stage 100 m Downstream of S-23A (ft NAVD88)
WY2011 Dry Season	11/22/2010	0.00	0.00	0.00
	12/20/2010	0.00	0.00	0.00
	1/24/2011	0.00	0.00	0.00
	2/24/2011	0.15	0.15	0.00
	3/25/2011	0.04	0.04	0.00
	4/25/2011	0.00	0.00	0.00
	Average	0.03	0.03	0.00
WY2012 Wet Season	5/26/2011	0.00	0.00	0.00
	6/24/2011	0.00	0.00	0.00
	7/25/2011	0.00	0.00	0.00
	8/25/2011	0.47	0.47	0.50
	9/14/2011	0.60	0.60	0.60
	10/25/2011	0.68	0.64	0.70
	Average	0.35	0.34	0.36
WY2012 Dry Season	11/22/2011	0.13	0.12	0.00
	12/21/2011	0.08	0.06	0.00
	1/24/2012	0.00	0.00	0.00
	2/24/2012	0.20	0.20	0.00
	3/28/2012	0.00	0.00	0.00
	4/24/2012	0.10	0.10	0.00
	Average	0.09	0.08	0.00
WY2013 Wet Season	5/24/2012	0.52	0.53	0.65
	6/29/2012	0.20	0.30	0.00
	7/25/2012	0.60	0.59	0.60
	8/28/2012	0.50	0.50	0.60
	9/13/2012	0.68	0.68	0.58
	10/25/2012	0.57	0.78	0.80
	Average	0.51	0.57	0.53

Table H-1. Continued.

Period	Date	Stage Upstream of S-23A (ft NAVD88)	Stage Downstream of S-23A (ft NAVD88)	Stage 100 m Downstream of S-23A (ft NAVD88)
WY2013 Dry Season	11/26/2012	0.20	0.18	0.60
	12/19/2012	0.00	0.00	0.00
	1/23/2013	0.29	0.28	0.00
	2/25/2013	0.40	0.42	0.60
	3/25/2013	0.40	0.40	0.60
	4/25/2013	0.27	0.24	0.60
	Average	0.26	0.26	0.36
WY2014 Wet Season	5/29/2013	0.00	0.00	0.00
	6/24/2013	0.00	0.00	0.00
	7/23/2013	0.00	0.00	0.00
	8/27/2013	0.55	0.53	0.60
	9/16/2013	0.75	0.74	0.60
	10/23/2013	0.00	0.00	0.70
	Average	0.22	0.21	0.32
WY2014 Dry Season	11/25/2013	0.50	0.70	0.60
	12/19/2013	0.00	0.00	0.80
	1/23/2014	0.00	0.00	0.60
	2/24/2014	0.00	0.00	0.60
	3/25/2014	0.00	0.00	0.60
	4/24/2014	0.10	0.12	0.60
	Average	0.10	0.14	0.63
WY2015 Wet Season	5/27/2014	0.19	0.20	0.60
	6/25/2014	0.60	0.59	0.70
	7/24/2014	0.48	0.47	0.60
	8/25/2014	0.48	0.45	0.60
	9/15/2014	0.66	0.64	0.60
	10/23/2014	0.00	0.00	0.25
	Average	0.40	0.39	0.56
WY2015 Dry Season	11/25/2014	0.00	0.00	0.00
	12/19/2014	0.00	0.00	0.00
	1/23/2015	0.00	0.00	0.00
	2/19/2015	0.00	0.00	0.00
	3/25/2015	0.00	0.00	0.00
	4/24/2015	0.00	0.00	0.00
	Average	0.00	0.00	0.00

Table H-2. Monthly water levels in feet National American Vertical Datum 1988 (ft NAVD88) upstream and downstream of S-23D and 100 meters downstream of S-23D.

Period	Date	Stage Upstream of S-23D (ft NAVD88)	Stage Downstream of S-23D (ft NAVD88)	Stage 100 m Downstream of S-23D (ft NAVD88)
WY2011 Dry Season	11/22/2010	0.00	0.00	0.20
	12/20/2010	0.00	0.00	0.20
	1/24/2011	0.00	0.00	0.00
	2/24/2011	0.15	0.05	0.00
	3/25/2011	0.00	0.00	0.00
	4/25/2011	0.00	0.00	0.00
	Average	0.03	0.01	0.07
WY2012 Wet Season	5/26/2011	0.00	0.00	0.00
	6/24/2011	0.00	0.00	0.00
	7/25/2011	0.34	0.21	0.00
	8/25/2011	0.60	0.60	0.00
	9/14/2011	0.37	0.20	0.60
	10/25/2011	0.42	0.54	0.20
	Average	0.29	0.26	0.13
WY2012 Dry Season	11/22/2011	0.00	0.16	0.60
	12/21/2011	0.00	0.12	0.20
	1/24/2012	0.00	0.00	0.20
	2/24/2012	0.00	0.00	0.00
	3/28/2012	0.05	0.00	0.00
	4/24/2012	0.00	0.00	0.00
	Average	0.01	0.05	0.17
WY2013 Wet Season	5/24/2012	0.60	0.35	0.00
	5/24/2012	0.00	0.00	0.61
	6/29/2012	0.60	0.48	0.00
	7/25/2012	0.10	0.00	0.60
	8/28/2012	0.64	0.50	0.20
	9/13/2012	0.52	0.79	0.48
	10/25/2012	0.41	0.35	0.32
	Average	0.22	0.22	0.22

Table H-2. Continued.

Period	Date	Stage Upstream of S-23D (ft NAVD88)	Stage Downstream of S-23D (ft NAVD88)	Stage 100 m Downstream of S-23D (ft NAVD88)
WY2013 Dry Season	11/26/2012	0.00	0.00	0.60
	12/19/2012	0.00	0.00	0.00
	1/23/2013	0.00	0.00	0.20
	2/25/2013	0.20	0.10	0.00
	3/25/2013	0.00	0.00	0.00
	4/25/2013	0.04	0.02	0.16
	Average	0.04	0.02	0.16
WY2014 Wet Season	5/29/2013	0.00	0.00	0.60
	6/24/2013	0.00	0.00	0.00
	7/23/2013	0.47	0.35	0.20
	8/27/2013	0.76	0.73	0.20
	9/16/2013	0.00	0.00	0.80
	10/23/2013	0.21	0.18	0.33
	Average	0.50	0.40	0.20
WY2014 Dry Season	11/25/2013	0.00	0.00	0.40
	12/19/2013	0.00	0.00	0.10
	1/23/2014	0.00	0.00	0.00
	2/24/2014	0.00	0.00	0.00
	3/25/2014	0.00	0.00	0.20
	4/24/2014	0.08	0.07	0.15
	Average	0.01	0.01	0.14
WY2015 Wet Season	5/27/2014	0.00	0.00	0.10
	6/25/2014	0.15	0.05	0.00
	7/24/2014	0.51	0.40	0.10
	8/25/2014	0.68	0.58	0.10
	9/15/2014	0.56	0.44	0.20
	10/31/2014	0.66	0.68	0.29
	Average	0.43	0.36	0.13
WY2015 Dry Season	11/22/2014	0.69	0.72	0.52
	12/19/2014	0.68	0.69	0.51
	1/23/2015	0.61	0.65	0.39
	2/24/2015	0.67	0.67	0.26
	3/25/2015	0.59	0.58	0.22
	4/24/2015	0.48	0.52	0.21
	Average	0.62	0.64	0.35