Appendix 5-2: Annual Emergency Order Report for the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow

Emergency Order Report (May 1, 2011–April 30, 2012)
Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key emergency order-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. The FDEP has issued this emergency order to the US Army Corp of Engineers (USACE). The South Florida Water Management District (SFWMD or District), under an agreement with the USACE, conducts water quality monitoring and prepares this report annually for the USACE to satisfy certain monitoring and reporting requirements specified in the emergency order (EO).

During the reporting period, there was one excursion (pH at S332B) for water quality parameters based on Class III surface water quality standards. There was no concern for total phosphorus concentrations for surface water and groundwater for all monitored sites. For pesticides, the highest atrazine surface water concentration detected (0.053 micrograms per liter, or μg/L) is not expected to have an acute or chronic detrimental impact on fish or invertebrates. Total mercury levels measured from the three sites were well below the Southern Everglades 75th percentile concentration of 0.08 milligrams per kilogram (mg/kg) (for the period of record up to 2012) and the USEPA trophic level III fish protection criteria of 0.077 mg/kg, therefore demonstrating no threat to piscivorous avian and mammalian wildlife. Mercury levels in C-111 mosquitofish are below average levels found in several Stormwater Treatment Areas and all downstream Everglades monitoring locations. All sites in WY2012 display lower THg levels than the previous two water years.

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Table 1. Key emergency order-related information.

Project Name:	Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow
Permit Number:	Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242
Issue and Expiration Dates:	Issued: 1/31/2004 (modified 1/28/2008, in a letter from FDEP to USACE and SFWMD) Expires: Upon implementation of ERTP, unless rescinded, modified, or extended by further order of the Department.
Project Phase:	Construction of detention areas of S-332B, S-332C, and S-332D detention areas has been completed. The Everglades Restoration Transition Plan (ERTP) will replace the Interim Operational Plan (IOP) when the final Record of Decision is signed.
EO/Permit Specific Condition Requiring Annual Report:	25
Reporting Period:	May 1, 2011–April 30, 2012
Report Lead:	Shi Kui Xue sxue@sfwmd.gov 561-682-2333
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Interim Operational Plan Water Quality Sampling Sites, Monitoring Schedule, Flow Volumes and Flow-Weighted Mean Concentrations for Water Year 2012
C	Time-Series and Box Plots for Water Quality Monitoring Data Exhibiting Excursions from Class III Numeric Standards for Water Year 2012
D	Summary Statistics of C-111 Water Quality Monitoring Data for Water Year 2012
E	Time-Series and Box Plots of Total Phosphorus and Total Nitrogen at Monitoring Sites for Water Year 2012
F	Water Quality Data
G	Hydrologic Data

INTRODUCTION

The Central & Southern Florida Flood Control Project Comprehensive Review Study (Restudy; USACE and SFWMD, 1999) was authorized by the Water Resources Development Act of 1992 to determine the effects of the existing canal system on the Everglades and neighboring sensitive areas and to develop a conceptual plan to restore the remaining Everglades while maintaining the water supply and flood protection functions of the Central and Southern Florida Flood Control Project (C&SF Project). Upon its completion in 1999, the Restudy was renamed the Comprehensive Everglades Restoration Plan (CERP) (U.S. Congress, 2000).

The C-111 Canal Project modifications—authorized by the 1994 General Reevaluation Report (GRR), along with the Modified Water Deliveries to Everglades National Park (MWD ENP) Project, authorized by the 1992 General Design Memorandum (1992 GDM) —must be completed before the decompartmentalization components of CERP can be initiated. Considerable portions of the C-111 Canal Project modification have been built and were operating under the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) during Water Year 2012.

The Everglades Restoration Transition Plan (ERTP) for the MWD ENP and C-111 Canal projects is replaced the IOP for Protection of the CSSS when the final Record of Decision was signed on October 19, 2012. The purpose of the ERTP is to define operations for the constructed features of the MWD and C-111 projects until those projects are fully completed and a Combined Operation Plan (COP) is implemented. These projects consist of structural changes to the South Dade Canal Conveyance System to provide more natural water levels in Everglades National Park (ENP or Park), provide water to the ENP, reduce damaging discharges to Florida Bay, and maintain the historical drainage level of the South Dade canals. The C-111 Canal Project includes the construction of three pump stations (S-332B, S-332C, and S-332D) to move water from the L31-N reach located between S-331/S-173 and S-176 into the newly constructed detention areas located along the eastern boundary of the ENP. **Figures 1** and **2** show the general location of the facilities monitored under this plan and the locations of major canals and roads in this vicinity.

The U.S. Army Corps of Engineers (USACE) submitted an application to the Florida Department of Environmental Protection (FDEP) on December 14, 1999, for an Environmental Resource Permit (ERP) to operate the S-332B, S-332C, and S-332D structures, in accordance with the IOP for Protection of the CSSS. The C-111 Canal Project's Ninth Amended Emergency Final Order (C-111 EO #9) (FDEP Nos. 00-0889 and 99-2242) authorizes the USACE to operate and monitor structures S-332B, S-332C, and S-332D pump stations and associated detention areas. Operations during water year 2012 were in accordance with guidelines identified in Table 2.11 of the Final Environmental Impact Statement for the IOP for Protection of the CSSS and the Water Quality Monitoring Plan found in Exhibit B of C-111 EO #9. The S-332B, S-332C, and S-332D pump stations and associated facilities are operated for flood protection, water supply to the ENP and Miami-Dade County, and routing of water from Water Conservation Area 3A (WCA-3A). These pump stations and facilities compensate for the closures of S-343A, S-343B, S-344, S-12A, S-12B, and S-12C as specified in the IOP for Protection of the CSSS to improve sparrow nesting conditions to comply with the U.S. Fish and Wildlife Service's (USFWS) February 19, 1999, Biological Opinion.

The USACE is authorized by the emergency order to construct and operate the accelerated (emergency) features of the C-111 Canal Project (S-332B to S-332C Detention Areas Offset Connector and Land Swap Detention Areas), as described in the IOP for Protection of the CSSS, and the modified weir scenario identified in Specific Condition 25(g). The Ninth Emergency Order was effective January 31, 2004, and states "the Department finds that this state of emergency is expected to continue up until implementation of the CSOP [Combined Structural and Operational Plan]. Therefore, this Emergency Final Order shall remain in effect until implementation of CSOP, unless rescinded, modified, or extended by further order of the Department". The ERTP is expected to supersede the IOP until the long-term operation plan is implemented. This long term operating plan is now called the Combined Operations Plan and has replaced the CSOP. The FDEP will reevaluate current project authorizations when proposed changes to current operational plans are finalized.

On January 19, 2004, the USACE entered into an agreement with the SFWMD to conduct water quality monitoring and reporting on its behalf to satisfy the emergency order requirements. The SFWMD coordinates with USACE to ensure these functions, including modifications, are accomplished in accordance with the EO issued to the USACE. On January 28, 2008, the Florida Department of Environmental Protection sent a letter to USACE and SFWMD for minor modification to the Ninth Amended Emergency Final Order for Specific Condition 25(b) to consolidate the quarterly reporting requirements into the South Florida Environmental Report (SFER).

Since 2004, the SFWMD has been conducting the water quality monitoring and compiling the annual reports for the USACE. The first four annual reports for calendar years 2004–2007 were submitted to FDEP. The next two annual reports for Water Year 2008 (WY2008)(May 1, 2007–April 30, 2008) and WY2009 are presented in Appendix 3A-8 of the 2009 and 2010 South Florida Environmental Reports (SFER) – Volume I. Reports for WY2010 and WY2011 are presented in Appendix 5-2 of Volume III of the 2011 and 2012 SFERs. This appendix is the ninth annual water quality monitoring report under the Emergency Final Order and presents water quality results for WY2012 (May 1, 2011–April 30, 2012).

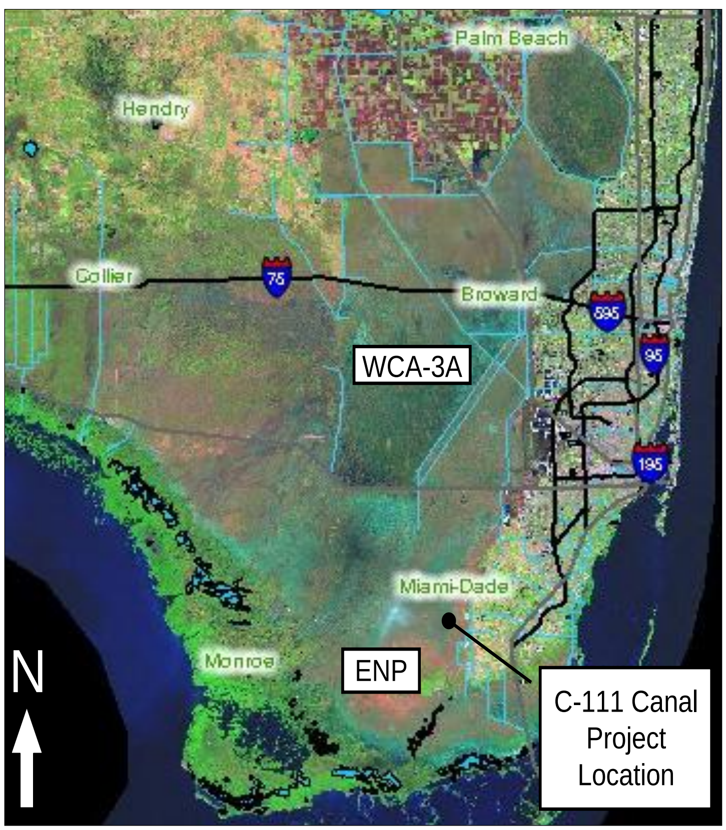


Figure 1. General location of facilities monitored under the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS).

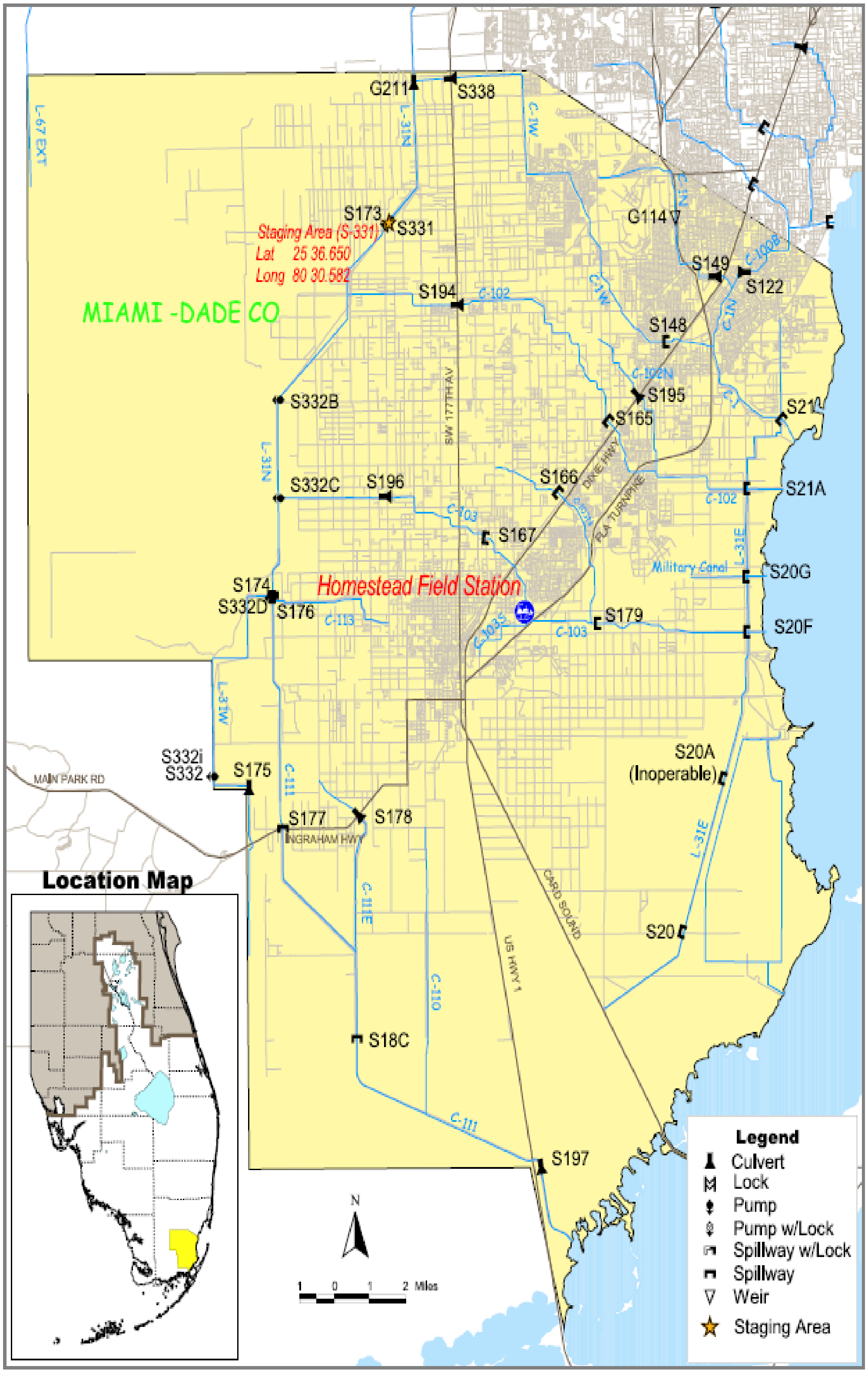


Figure 2. Major roads and canals within the C-111 Canal Project area.

METHODS

WATER QUALITY AND HYDROLOGIC DATA

The water quality and hydrologic data evaluated in this report are from DBHYDRO, the SFWMD hydrometeorologic database. Before water quality data are entered into the database, the District follows the strict quality assurance/quality control (QA/QC) procedures outlined in the FDEP-approved Quality Management Plan (SFWMD, 2011). The plan ensures that the water quality monitoring program provides accurate data. The SFWMD conducts the water quality monitoring program in accordance with the Water Quality Monitoring Plan approved by FDEP (dated January 31, 2004) for IOP Emergency Operations for the Cape Sable Seaside Sparrow Breeding Season. Methods for hydrologic data collection are documented in the Guidelines for the Collection of Hydrologic and Meteorologic Data (SJRWMD et al., 1994). The QA/QC procedures for hydrologic data are included in the Guidelines for Quality Control and Quality Assurance of Hydrologic and Meteorologic Data (SJRWMD et al., 1999).

DESCRIPTION OF FACILITIES

This section describes the S-332B, S-332C, and S-332D detention and buffer areas, systems, and function. The C-111 Canal Project, as modified by the 1994 GRR, will provide seepage management and water supply along approximately 12 miles (mi) between Richmond Drive (S-331/S-173) and S-175. The following descriptions include changes from subsequent authorizations (e.g., 2000 GRR for the 8.5 Square Mile Area feature of the MWD ENP project) and design refinements contained within the Tentatively Selected Plan of the ERTP that are within the authorization of the 1994 GRR (e.g., slight adjustment in the alignment of detention area levees).

The USACE construction work, conducted under the work package identified as Contract 7, was started in 2007 and completed in 2009. An interconnected detention system now exists from the S-332B west discharge to the S-332D high head cell. Contract 7 included the following construction items:

- Degraded the existing S-332B west detention area and reconstruct the northern and western levees at a higher elevation of 13 feet in relation to the National Geodetic Vertical Datum of 1929 (ft NGVD29), which is now the elevation of all other levees for the S-332B and S-332C features
- Demolished and removed the emergency overflow weir from the west side of the S-332B west detention area
- Continued levee work south from the S-332B western and eastern levees and connected to the S-332C detention cell
- Removed the north and south S-332C levees
- Continued construction of the levee from S-332C west and east levees to S-332D high head cell
- Connected the south discharge of S-332B and north discharge of S-332C west with the completion of the westernmost levee
- Removed the south partial connection levee from S-332B and the north partial connection from S-332B to complete the partial connector levee
- Completed the S-332D detention areas along the eastern and western sides of this newly created detention area
- Degraded the southern levee of the S-332C detention area

- Connected the northern portion of the C-111 detention system (S-332B and S-332C features down to the L31W) to the S-332D detention area with four sliding gated culverts with telemetry (S-332DX1) in the north S-332D detention area levee
- Constructed S-332DX1 between the east and west levee tie-ins to the S-332D high head cell
- Backfilled the L-31W levee canal because the levees crossed the canal to connect to the C-111 high head cell

Operations during water year 2012 were in accordance with IOP guidance and will be continued until another approved multiagency coordinated plan is available.

The C-111 South Dade County (SDC) Project modifications to the C&SF Project are defined by its authorizing legislation and the 1994 GRR. There are 11 contracts in the C-111 SDC project. Contracts 1 through 7 have been constructed, and Contract 8 has been designed but not constructed to date. Contract 8 includes the L-31W Connection between the 8.5 Square Mile Area (SMA) to the Northern Detention Area. The previous Contract 8 plans are being revised and it is on hold until an amendment to the Project Cooperation Agreement between the Corps and the SFWMD is finalized.

The planned contract 9 includes the following components:

- **Backfilling borrow canal.** The L-31W borrow canal is being backfilled to prevent the canal from acting as a sump and pulling water out of the ENP. While the groundwater losses from the ENP have not been quantified, the backfill is beneficial based on a qualitative analysis of the area and comparison to other similar projects.
- **Installing overflow weir.** During the 2002 CSSS Emergency Contract, a 2,000-foot reach of L-31W was degraded to grade (approximate elevation 4 ft NGVD29) to allow water flowing through the Frog Pond Detention System to be delivered to Taylor Slough. To make the flow-way area a more functional part of the detention system and augment the delivery of water to Taylor Slough, this gap will be closed and replaced with a concrete overflow weir.
- **Demolishing existing structures.** The S-174 culvert structure is no longer able to operate when the L-31W borrow canal is filled. This culvert will be grouted in place and all superstructures will be removed.
- **Modifying pump station.** The S-332 pump station was originally planned to have a canal connecting it to C-111 to pump water to the west. However, this is no longer a viable option due to the filling in of the L-31W canal. Therefore, this structure will be removed and the existing footprint will be backfilled along with the adjacent canal area. The S-175 gated control structure will no longer be able to operate when the L-31W borrow canal is filled; therefore, this structure also will be completely removed.

Contract 10 includes a permanent pump station S-332B and discharge canal, permanent pump station S-332C, and an aboveground discharge flow-way. Contracts 9, 10, and 11 are under design and are expected to be completed under a future project.

S-332B and S-332C Detention Areas

A segment of the L-31W canal was backfilled in September 2007 to allow construction of the detention area connecting S-332D and S-332C. Modification of S-332D's high head cell made northward flow possible after the S-332B and S-332C detention areas were completed. The S-332B and S-332C detention areas currently cover approximately 2.5 mi of the approximately 8 mi between the southern end of the 8.5 Square Mile Area Stormwater Treatment Area (8.5 SMA STA) and the S-332D system (L-31W, S-176, and C-113). **Figures 3** and **4** provide more detailed maps of the S-332B and S-332C facilities, respectively. The connector cell between S-332B and S-332C has been completed.

A land swap (about 1,000 acres) between the SFWMD and the ENP was completed in March 2006 to allow the construction of a continuous detention area from S-332B west to S-332D as shown in **Figure 5**. This construction was completed in August 2008. In addition, the connector cell has been built to receive water from the main cell when depths in the main cell approach 2 ft. In this same period, construction of additional eastern and western levees created a continuous detention area from S-332B west through what is now the S-332C detention area. This expanded detention area extended into the S-332D detention area northern levee (the L-31W levee). A continuous detention area extending from S-332B north to the 8.5 SMA STA has been constructed in a separate phase once the required land is acquired (**Figure 6**) and the required USACE authorization is obtained. The acquisition of the parcels required for this northern portion was negotiated in April 2008, and was executed at the June 2008 SFWMD Governing Board meeting.

The temporary S-332B and S-332C pump stations are currently operated (flow rate and durations) to create a groundwater ridge without meaningfully exceeding a depth of 2 ft or causing surface water overflow into the ENP. These operations are similar to, but more constrained than, the operation envisioned in the 1994 GRR. When sufficiently filled, the S-332B and S-332C detention system establishes a hydraulic ridge, thereby allowing the water levels in the ENP to be higher while maintaining existing drainage for the land located east of the L-31N canal. **Figures 7**, **8**, and **9** illustrate the existing problem and solutions.

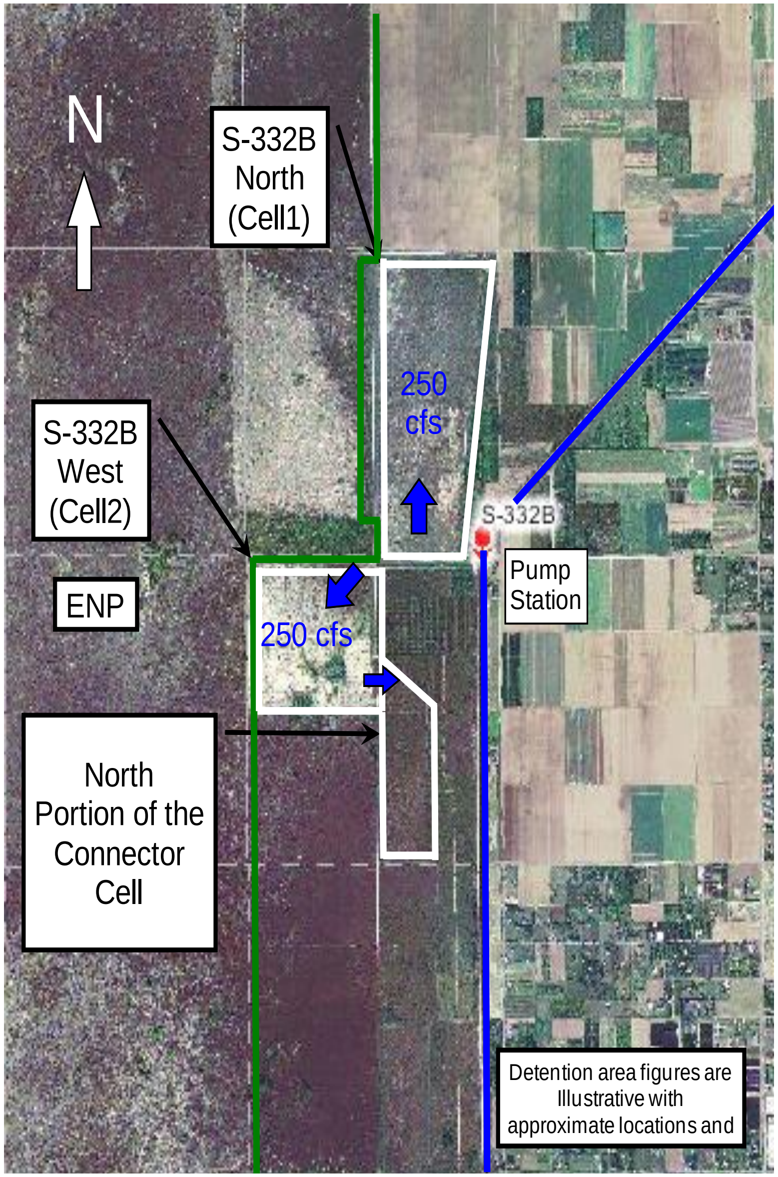


Figure 3. Location of S-332B pump stations and detention areas.

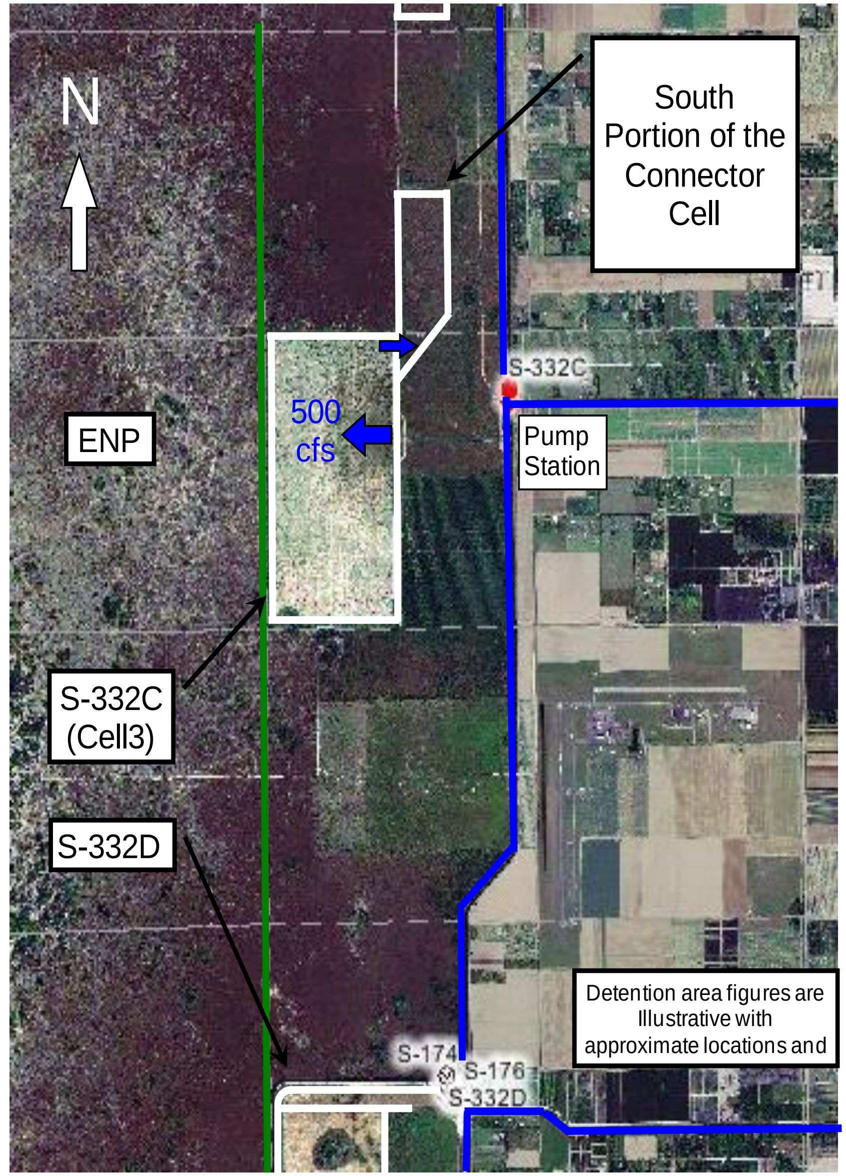


Figure 4. Location of S-332C pump stations and detention areas.

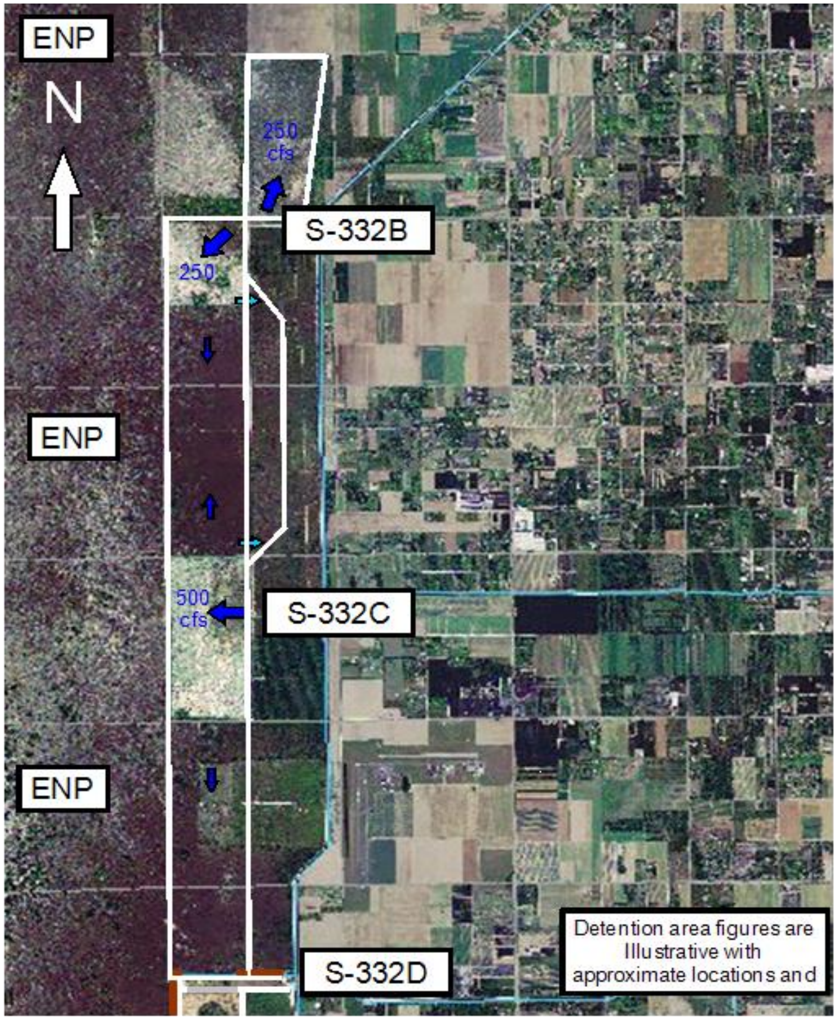


Figure 5. Location of S-332B, S-332C, and S-332D pump stations and detention areas (south).

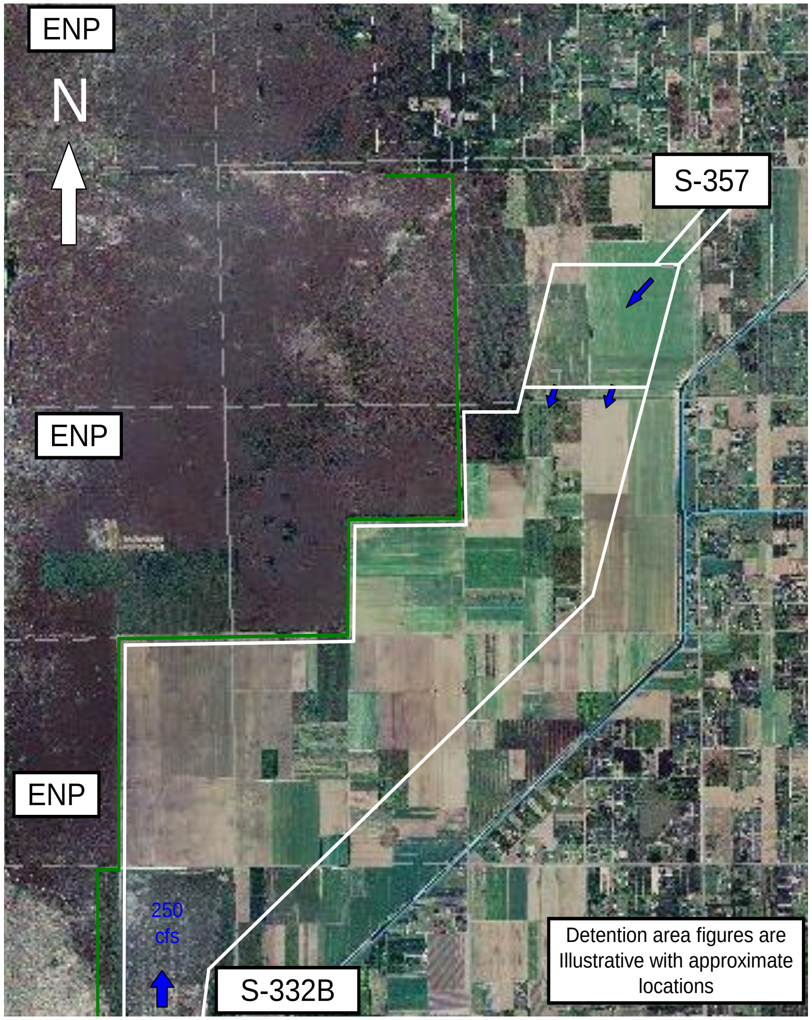


Figure 6. Location of S-332B pump station and detention area (north).

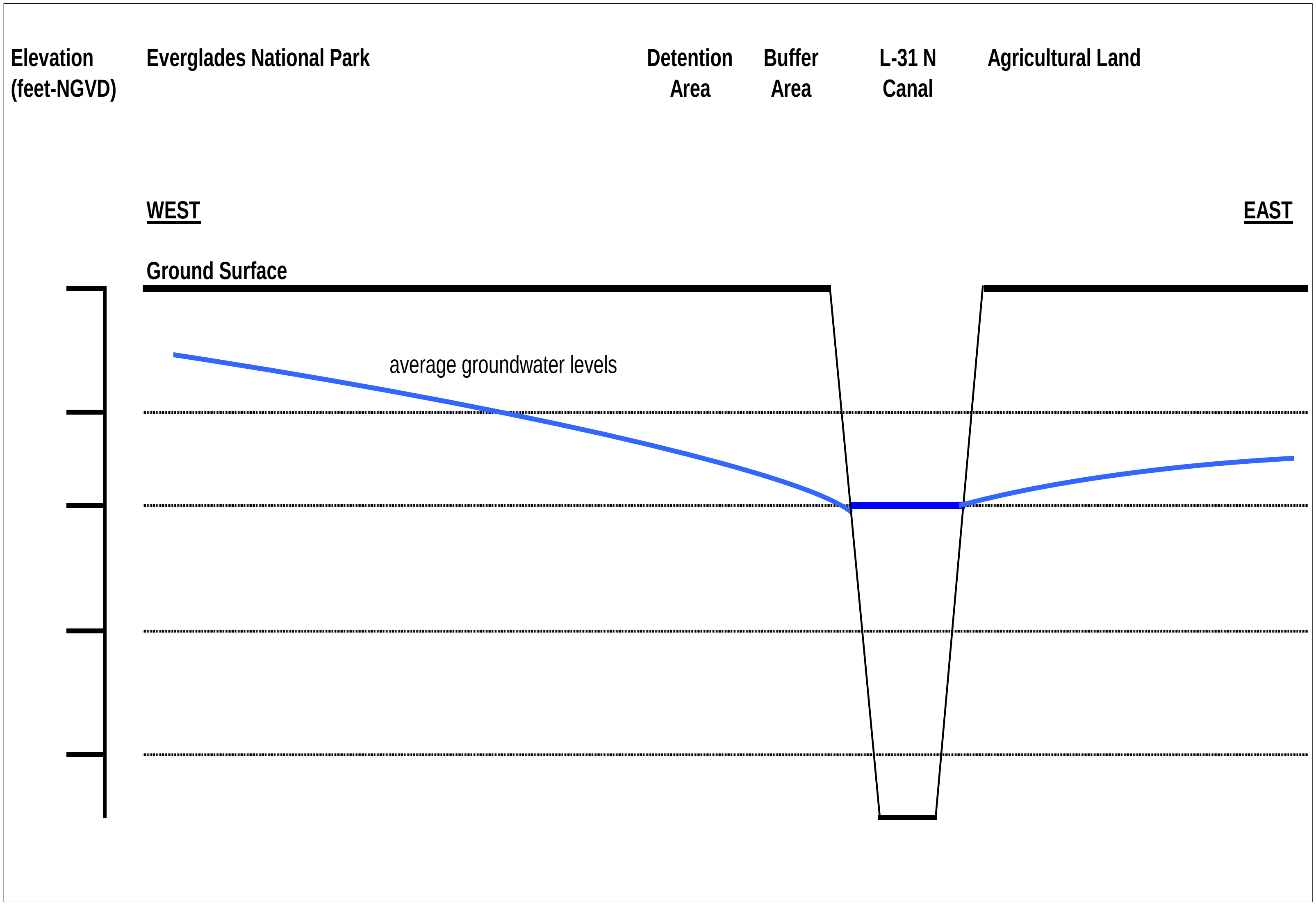


Figure 7. Generalization of groundwater flow near the L-31N canal without the project [Note: Figure is for illustration only and not to scale].

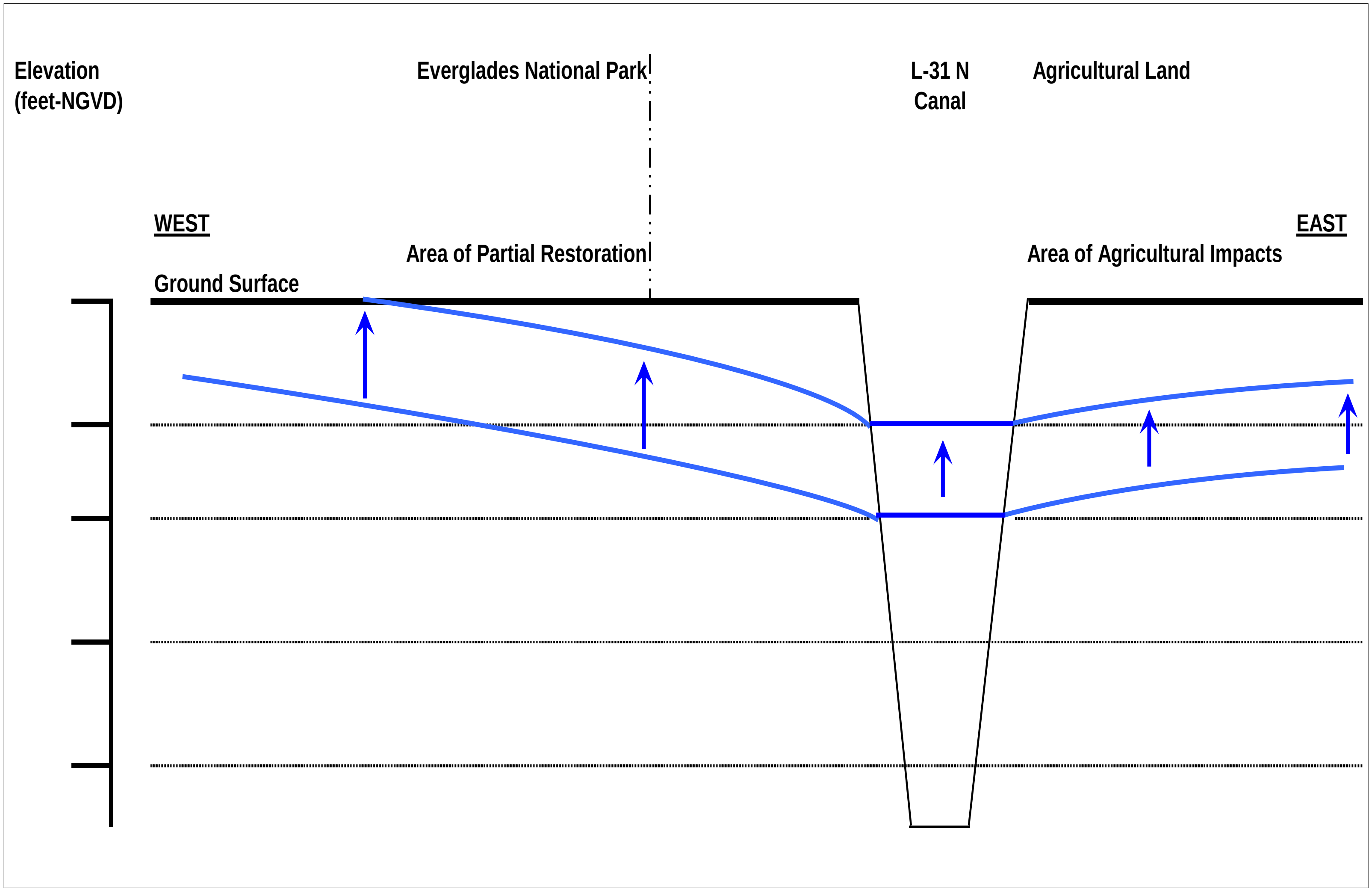


Figure 8. Illustration of potential impacts associated with partial restoration without the detention area [Note: Figure is for illustration only and not to scale].

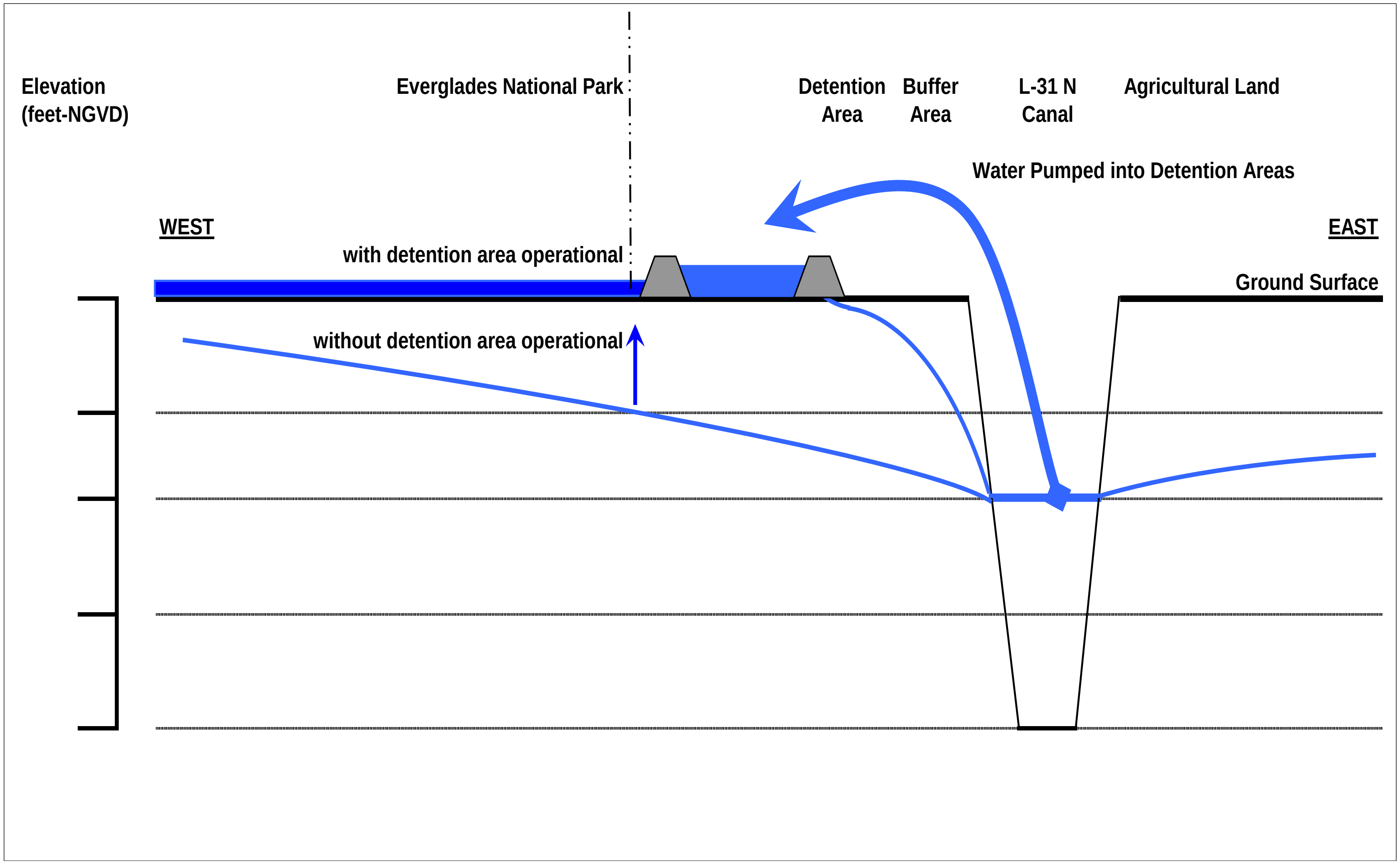


Figure 9. Generalization of groundwater flow near the L-31N canal with the detention area operational. [Note: Figure is for illustration only and not to scale].

The S-332B north reservoir, renamed the S-332B north detention area, has been built. The connector cell and the raising of S-332B west's western levee and weir was completed. However, to comply with the intent of the IOP for Protection of the CSSS, given the additional operational flexibility provided by completion of the S-332B north detention area, the SFWMD operates S-332B west to minimize surface water discharges. Some water is still delivered to the ENP via groundwater seepage. However, most water pumped into the detention areas returns to the canal due to the proximity and stage of the L-31N canal. The amount of water pumped into the S-332B north, S-332B west, and S-332C detention areas that returns as seepage varies depending primarily on the water level in and around the detention areas (e.g., the ENP and the buffer area) and the stage in L-31N. The estimated seepage return rate ranges from 60 to 100 percent. The average seepage return rate is approximately 70 percent when the detention areas are operational.

The IOP for Protection of the CSSS limits the normal water depths to 2 ft in the S-332B, S-332C, and connector cell, but allows depths up to 4 ft for named storms (e.g., hurricanes, tropical storms, and tropical depressions) and unnamed storms when the USACE determines there is a flood emergency. The depth limit of 2 ft and desire to eliminate surface water discharges complicates and constrains the operation of the incomplete detention areas. The current conditions of the S-332B and S-332C detention areas are as follows:

- **S-332B north.** The S-332B north detention area covers approximately 240 acres (ac) and can receive flow from two of the four 125 cubic feet per second (cfs) diesel pumps located within the temporary S-332B pump station. The topsoil of this former agricultural land (created predominately by rock plowing) was scraped from the interior of the detention area and used for construction of the levees. This detention area has been functional since April 30, 2003, but operations have generally been limited to one 125 cfs pump to prevent impacts to nearby privately owned agricultural land.
- **S-332B west.** The S-332B west detention area covers approximately 160 ac and can receive flow from two of the four 125 cfs diesel pumps and one 75 cfs electrical pump in the temporary S-332B pump station. The topsoil of this land was scraped from the interior of the detention area and used for levee construction. This detention area initially became functional on April 17, 2000, but was taken offline for rerouting required for construction of the S-332B north detention area. It returned to operational status on April 17, 2002. During initial operations, before construction of S-332B north, S-332B west received the entire discharge from S-332B and was operated under the 2001 Interim Structural and Operational Plan. This allowed discharges of up to 325 cfs into the S-332B west detention area without a depth limit, resulting in regular overflow from the western weir.
- **S-332C detention area.** The S-332C detention area covers approximately 300 ac and can receive flow from four 125 cfs diesel pumps and one 75 cfs electrical pump in the temporary S-332C pump station. The topsoil of this land was scraped from the interior of the detention area and used for construction of the levees. This detention area has been functional since August 2, 2002.
- **Partial connector cell between S-332B west and S-332C.** The USACE has built a continuous detention area from S-332D to S-332B north as part of the emergency construction for the IOP for Protection of the CSSS. To provide some of the completed project function, the USACE designed the connector cell east of the ENP eastern boundary at that time (now moved west with the land exchange). The connector cell's relatively narrow design was to achieve a limited hydraulic ridge while maintaining sufficient distance from the L-31N canal to have

manageable seepage losses. Both the northern portion (connected to S-332B west) and southern portion (connected to S-332C) have a continuous levee with no western (ENP) discharge structure. Land ownership limited the use of these detention areas until 2005. The flashboard riser that conveys water into these detention areas was lowered before the 2006 wet season to increase the use and function of the two areas. Construction of the remaining portions of the connector cell was completed in 2009. The top soil of this land was scraped from the interior of the constructed portion of the connector cell and used for construction of the levees.

- **Final detention area between S-332B west and S-332D** (**Figure 5**). Construction of the final detention area between S-332B west and S-332D was completed in 2009. This detention area received inflow from both the S-332B (two 125 cfs diesel pumps and one 75 cfs electrical pump) and S-332C (four 125 cfs diesel pumps and the one 75 cfs electrical pump) pump stations. The final detention area extends from and includes the S-332B west and S-332C detention areas and ends at the S-332D system. The final detention area covers approximately 1,300 ac, which is about 840 ac more than the 460 ac provided by S-332B west and S-332C detention areas.
- **Final detention area between S-332B north and the 8.5 SMA STA (Figure 6)**. Construction of the final detention area between S-332B north and the 8.5 SMA STA (Contract 8) is on hold until an amendment to the Project Cooperation Agreement between the Corps and the SFWMD is finalized. The remaining land was acquired in May 2008. This detention area can receive inflow from both the S-332B (two 125 cfs diesel pumps) and the S-357 pump stations (four 125 cfs diesel pumps and one 75 cfs electrical pump) via the 8.5 SMA STA. The final detention area will extend from and include what is now the S-332B north detention area and end at the 8.5 SMA STA. The final detention area will cover approximately 1,440 ac, which is about 1,000 ac more than the 460 ac provided by S-332B north.

S-332D Detention Areas

The IOP for Protection of the CSSS allows surface water discharges into Taylor Slough during the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) nesting season according to the following guidelines: (1) maximum of 500 cfs from July 16 (or end of the breeding season, as confirmed by USFWS) to November 30, (2) maximum of 325 cfs from December 1 to January 31, and (3) maximum of 165 cfs from February 1 to July 15.

As shown in **Figure 10**, the discharges from the S-332D pump station flow through a high head cell (west) and then through two detention areas (south then west) and finally through a flow-way area (south) before discharging into Taylor Slough near S-332. The high head cell and detention areas lose considerable flow to seepage both to the east (ultimately to the C-111 canal) and into the L-31W canal located along the western and northern sides of the S-332D detention system. The S-332D pump station became operational on August 31, 1999. Water from this pump station is discharged into the L-31W borrow canal. In June 2002, the S-332D detention (Frog Pond) area came online. Detailed descriptions of the individual components of the S-332D detention system follow:

- **S-332D header cell** (**Figure 10**, panels A and B). The S-332D header cell covers approximately 39 ac, has an average bottom elevation of approximately 5.5 ft NGVD29, and has a 1,820-ft-long discharge weir with a crest elevation of 8.2 ft NGVD29. The top soil of the interior of this detention area was scraped and used for construction of the levees. The S-174 structure was plugged in September 2007 and cell 4 was connected to the north detention area.

- **S-332D first detention area** (Cell 4 of **Figure 10**). The S-332D first detention area covers approximately 350 ac, has an average bottom elevation of approximately 5.3 ft NGVD29, and has an earthen berm acting as a broad crested weir with a top elevation of approximately 6.7 ft NGVD29. With the exception of the tree island located within this detention area, the top soil of this land was scraped from the interior and used for construction of the levees.
- **S-332D second detention area** (Cell 5 of **Figure 10**). The S-332D second detention area covers approximately 400 ac, has an average bottom elevation of 5.1 ft NGVD29, and has a weir crest elevation of approximately 6.0 ft NGVD29. The 1,900-ft long weir is constructed of concrete and discharges into the scraped portion of the flow-way. With the exception of the tree island located within this detention area, the top soil of this area was scraped from the interior and used for construction of the levees.
- **S-332D flow-way** (flow-way of **Figure 10**). The flow-way covers approximately 1,300 ac and discharges through an approximately 2,000-ft long levee gap in the southwest corner near S-332. The scraped surface of limestone acts as the discharge weir for the flow-way with an elevation of approximately 4 ft NGVD29. Discharges from the flow-way are spread and conveyed to Taylor Slough by the L-31W canal. The ground surface within the flow-way is lower toward the southwest with all of the land below 5.0 ft NGVD29, about a third of the land below 4.5 ft NGVD29, and about 8 percent below 4.0 ft NGVD29. An approximately 2,000-ft wide portion of the flow-way was scraped, and this material was used for construction of the levees and stockpiled near the southeast corner of the flow-way.

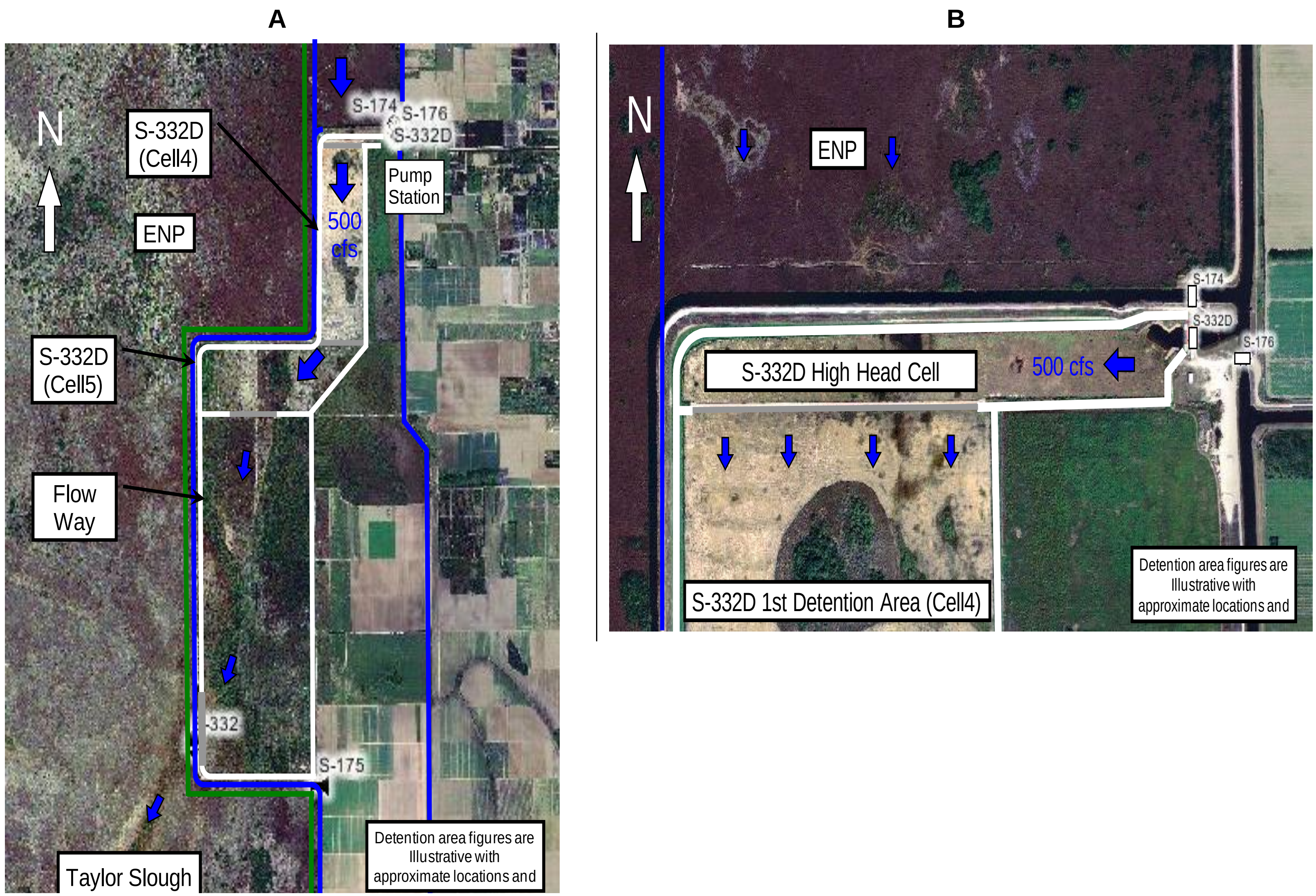


Figure 10. Location with flow arrows of the S-332D pump station and detention areas (panel A), and a closer view of the S-332D pump station, high head cell, and first detention area (Cell 4)(panel B).

SAMPLING SITES

In addition to authorizing the operation and maintenance of certain structures, C-111 EO #9 requires a routine water quality monitoring program. This program characterizes the quality of water discharged from the three pump stations that move water from the L-31N canal reach between S-331/S-173 and S-176 into the detention areas (S-332B, S-332C, and S-332D), two interior detention areas (CULC1 and CULC2), four diversion structures (DS1, DS2, DS3, and DS4), and one outflow structure (BERMB3), as shown in **Figure 11**. Cell 5 is separated from the flow-way by a concrete berm (B3). The flow-way discharges into ENP through a degraded portion of the L-31N levee, however, depending on water levels, water may flow from the ENP into the flow-way. Given the problems with measured flow at the degraded levee, berm B3 is used as a surrogate for both flow and nutrient discharges into the ENP.

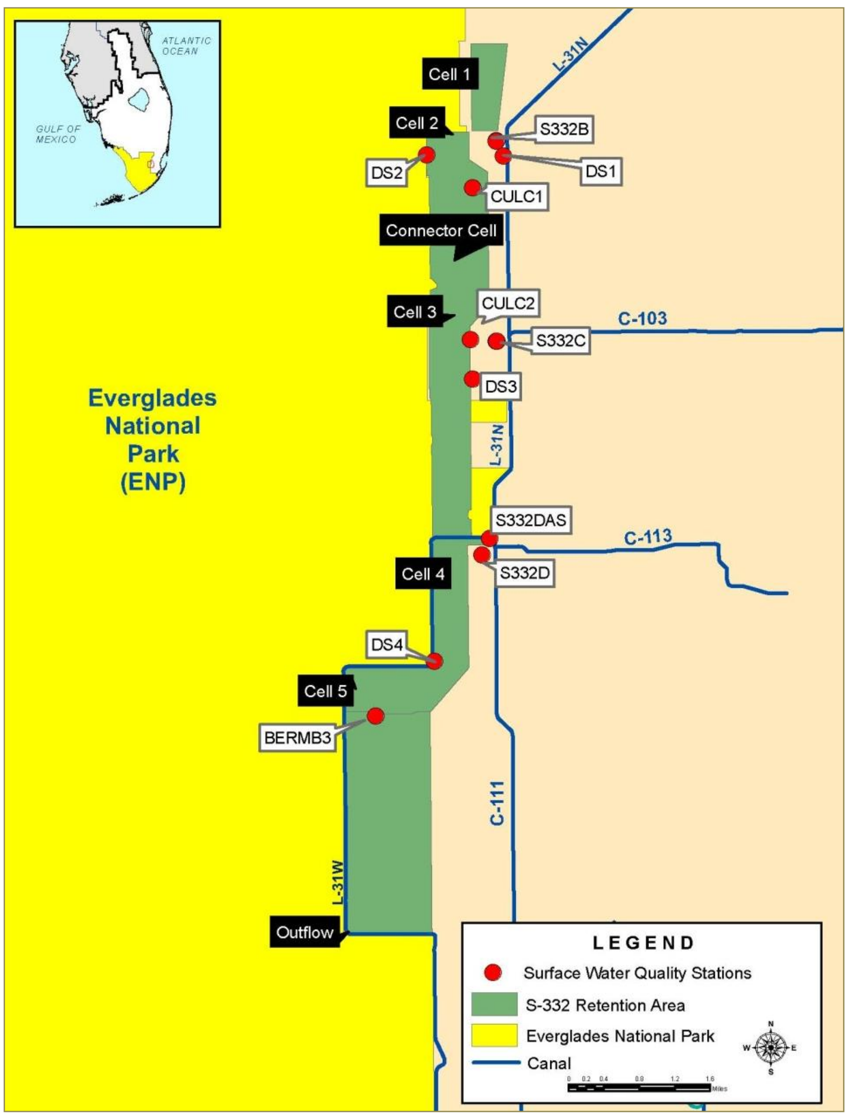


Figure 11. Monitoring locations for S-332B, S332C, and S-332D detention areas.

The DS1 and DS3 structures are the emergency overflow weirs for S-332B and S-332C. Both discharge to the east and therefore cannot discharge into the ENP. The DS2 structure can discharge into the ENP (to the west) if the stage within the detention area exceeds the crest elevation of approximately 8.39 ft NGVD 29 along the 1,700 lineal feet of weir. The DS4 structure consists of manually operated sluice gates that are opened only for emergencies (e.g., a detrimental fire) requiring more rapid delivery of water than provided by the S-332D detention system.

The District typically collects water quality samples at the structure or at a nearby location representative of the quality of water flowing through a structure. The District previously submitted a monitoring plan to the FDEP on January 4, 2004, that included detailed information on the specific locations for sample collection for S-332B, S-332C, S-332D, and associated structures. The current monitoring program encompasses 10 locations that provide representative information to characterize the quality of water discharged through all structures. The structure names, representative water quality monitoring location names, and sampling frequencies of the various categories of chemical constituents and physical properties required by the monitoring schedule denoted in the C-111 EO #9 are shown in Attachment B, **Table B-1**.

DATA ANALYSIS PERIODS

The water quality characterization includes an evaluation of compliance with Class III criteria for each monitoring location representative of C-111 Canal Project emergency operation structures. This report provides the annual update of the C-111 EO #9 monitoring program and a comparison of water quality data at structures to state water quality standards for WY2012. These comparisons fulfill the C-111 EO #9 requirements to measure progress toward achieving and maintaining compliance with state water quality standards.

Method Detection Limits

Each water quality constituent has a method detection limit (MDL) that essentially defines the minimum concentration, or level, at which the constituent can be quantified. The MDL is usually twice the background noise level associated with a test and represents the level at which the presence of the analyte can be reliably determined. The MDL does not represent a level at which an exact measurement can be determined.

The practical quantitation limit (PQL) represents the lowest level achievable among laboratories within specified limits during routine laboratory operations and for which a measurement can be considered quantifiably reliable for a constituent. Generally, the PQL is four times the MDL, although different laboratories may establish PQLs at two to five times the MDL.

In this report, data reported to be less than the MDL were assigned a value equal to the MDL to provide a conservative basis for statistical analysis. For pesticide detections, concentrations greater than the PQL were considered reliable.

Excursion Analysis for Class III Constituents and Pesticides

To evaluate compliance with water quality criteria, constituent concentrations were compared to their respective Class III numeric criteria. If a constituent concentration exceeded its numeric criterion, then an excursion was recorded and the total number and percent of excursions for the C-111 EO #9 structures were tabulated.

Total Phosphorus

Total phosphorus (TP) data are presented in this report in time-series plots and statistical box plots. The Everglades Forever Act (EFA) [Section 373.4592, Florida Statutes (F.S.)] mandates that the numeric TP criterion for Class III waters in the Everglades Protected Area (EPA) should be a long-term geometric mean of 10 parts per billion (ppb), but should not be lower than the natural conditions of the EPA, and should take into account spatial and temporal variability [Chapter 62-302.540, Florida Administrative Code (F.A.C.), Water Quality Standards for Phosphorus Within the Everglades Protection Area]. There are additional TP concentration compliance limits for inflows to the ENP by way of Shark River Slough (e.g., S-343A, S-343B, S-344, S-12A, S-12B, S-12C, S-12D, S-333 minus S-334, S-355A, S-355B, and S-356), Taylor Slough (S-332D), and the coastal basin (S-18C) outlined in the Settlement Agreement; however, this report does not track compliance with the interim or long-term TP concentration limits set forth in the agreement.

The District's categories of "concern," "potential concern," and "no concern" are based on a common sense understanding of water resources protection. However, these terms are not intended to be interpretations of state water quality standards or state water quality law. The FDEP, not the District, is responsible for interpreting whether a given constituent violates (1) the numeric criterion, (2) the narrative criterion, (3) a water body's designated uses, or (4) the anti-degradation policy.

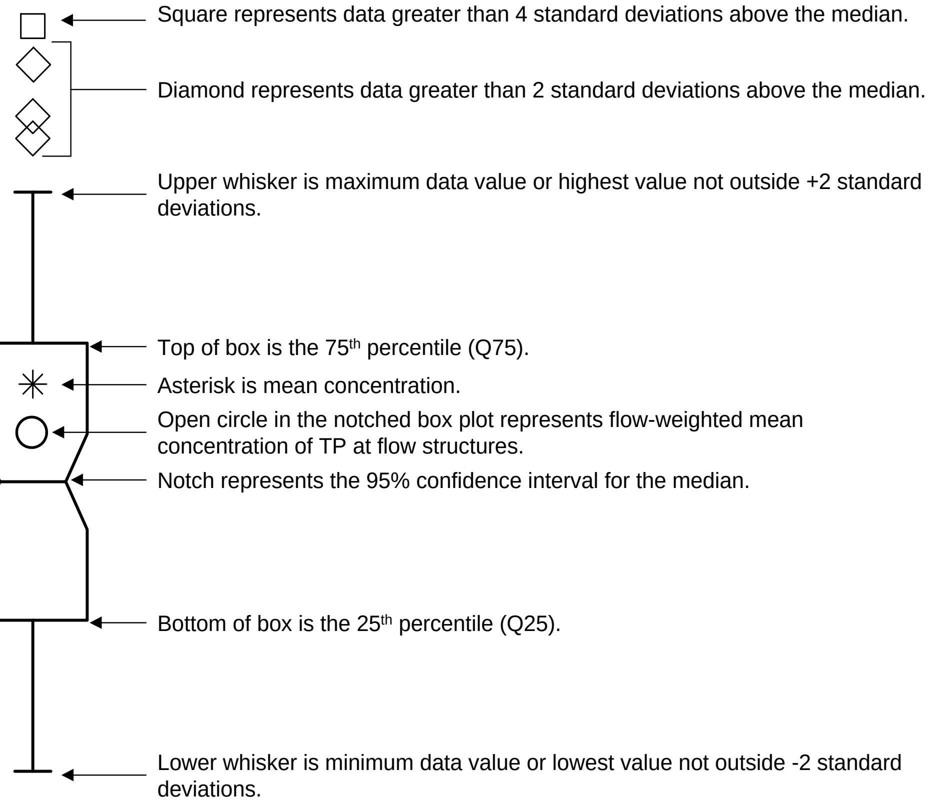
Mercury

The C-111 Canal Project originally had two mercury monitoring components: total mercury (THg) and methylmercury (MeHg) analysis in surface water, and THg in fish. The current monitoring program is based on several changes approved by FDEP (August 2006), and these are described further. Initial surface water mercury monitoring, which was conducted at three inflows to the project (S332B, S332C, and S32D) and the outflow (BERMB3), was discontinued. For mercury monitoring in fish, the collection of largemouth bass was discontinued, and the collection frequency changed from quarterly to annual for mosquitofish (*Gambusia holbrooki*), from cells 1, 2, 3, 4, 5, the connector cell and flow-way cell, which are collected under the following designations: DS1 (eastern edge of Cell 1), DS2 (western edge of cell 2), CULC2 (eastern edge of cell 3), DS4 (western edge of cell 4), BERMB3 (upstream for cell 5 and downstream for flow way cell) and CULC1 (connector cell). The required annual samples for mosquitofish were collected at all 7 stations in WY2012.These sites are shown in **Figure 11**.

DESCRIPTION OF NOTCHED-BOX-AND-WHISKER PLOTS

Notched-box-and-whisker plots were created to summarize data for each constituent that exceeded its numeric criteria and to summarize the TP data collected at all monitoring locations. A notched-box-and-whisker plot summarizes selected statistical properties of the datasets. Notched-box-and-whisker plots can be used to test for statistical significance between datasets at a roughly 95 percent confidence interval, to detect changes in constituent concentration variability over time, and to determine if trends exist. The notched-box-and-whisker plots used for these summaries are based on McGill et al. (1978) (**Figure 12**).

It is recognized that using notched-box-and-whisker plots to determine differences between datasets with large differences in sample size may cause significant findings that are artifacts of the number of samples and the amount of variation in the datasets. The objective of providing the plots was to evaluate data from WY2012 and future changes for the discharge structures. Notched-box-and-whisker plots of total phosphorus (TP) and total nitrogen (TN) data for WY2012 are provided in Attachment D.



- Notches surrounding the medians provide a measure of the significance of differences between notched-box plots. If the notches surrounding two medians do not overlap, then the medians are significantly different at about a 95 percent confidence level.
- At times, the variability in a dataset may be quite high. When highly variable data are presented in a notched box-and-whisker plot, the width of the notch may be greater than the 25th or 75th percentile. When this occurs, the box plot appears as if it is folded from the end of the notch back towards the median. This is done

$$Notch = Median \pm \frac{1.58(Q75 - Q25)}{\sqrt{n}}$$

Where n = number of data points shown on the bottom of **Figure 13**

Figure 12. Description of notched-box-and-whisker plots used in this report.

RESULTS: WATER QUALITY EVALUATION AND EXCURSION ANALYSIS

This section presents an update of constituent concentrations and physical properties measured during WY2012. For standards with numeric criteria, the data from the structures were assessed for compliance with those standards using the procedures in Chapter 62-302, F.A.C. (Surface Water Quality Standards) or Chapter 62-160, F.A.C. (Quality Assurance Rule). For parameters that have narrative water quality criteria, the concentrations obtained at each structure were reported using plots and summary statistics.

MONITORING OF PHYSICAL PARAMETERS, NUTRIENTS AND MAJOR IONS

Descriptive Statistics

A summary of the data with descriptive statistics for all water quality constituent concentrations and physical properties (excluding pesticides and priority pollutants) measured for C-111 EO #9 monitoring locations during WY2012 is in Attachment D. A reference reflecting current state Class III criteria is provided in Attachment D, **Table D-1**. Attachment D, **Table D-2** cross references water quality monitoring sites with the C-111 EO #9 discharge structures. Attachment D, **Table D-3** summarizes the descriptive statistics for each water quality parameter collected for all monitoring stations.

The statistical summary table (Attachment D, **Table D-3**) reports the range of constituent concentrations, median values, the number of sample observations, selected data percentiles (25^{th} and 75^{th}), and parameters exhibiting excursions from Class III numeric criteria. Concentrations observed to be less than the lower limit of the analytical MDL were set equal to the MDL for statistical analysis.

For parameters that only have narrative criteria (e.g., nutrients), the tables provide basic information to assist with identifying water quality constituents that might be of concern. TP is the nutrient deemed to be of particular concern for the C-111 EO #9 structures.

Excursions from Class III Criteria (Numeric)

Further analysis of excursions from Class III criteria was accomplished by summarizing the excursions, plotting the data for parameters exhibiting the excursions, discussing the parameters, and noting which ones are a concern. The excursion analysis is based on four water quality parameters (with a numeric criteria) that were collected for the C-111 EO #9 monitoring program and can be compared with applicable Class III water quality criteria listed in Chapter 62-302.530, F.A.C.

Of the parameters listed in **Table 3**, only one exhibited excursions (pH at S332B) during WY2012. A summary for individual C-111 EO #9 monitoring locations during WY2012 is in **Table 4**. The monitoring locations are categorized in the table as inflow, interior, diversion, and outflow. Calculated criteria for the parameters were derived from the equation listed in Chapter 62-302.530, F.A.C.

Table 3. Summary of total number of excursions from state Class III criteria for all C-111 EO #9 monitoring sites.

Period	Total Alkalinity	Dissolved Oxygen	Specific Conductance	pH	Turbidity	Un-Ionized Ammonia	Total Iron	Total Cadmium	Total Copper	Total Zinc
CY2004	(0 : 11)	(**121 : 129**)	(0 : 121)	(0 : 130)	(0 : 69)	(0 : 77)	(0 : 9)	(0 : 6)	(0 : 5)	(0 : 6)
CY2005	(0 : 20)	(**144 : 173**)	(0 : 171)	(0 : 174)	(0 : 104)	(0 : 103)	(0 : 13)	(0 : 11)	(0 : 11)	(0 : 11)
CY2006	(0 : 10)	(**110 : 128**)	(0 : 129)	(0 : 131)	(0 : 68)	(0 : 55)	(0 : 10)	(0 : 11)	(0 : 11)	(0 : 11)
CY2007	(0 : 5)	(**84 : 141**)	(0 : 153)	(0 : 153)	(0 : 39)	(0 : 18)	(0 : 4)	(0 : 1)	(0 : 1)	(0 : 1)
WY2008	(0 : 2)	(**88 : 144**)	(0 : 156)	(0 : 156)	(0 : 31)	(0 : 8)	(0 : 2)	(0 : 0)	(0 : 0)	(0 : 0)
WY2009	(0 : 0)	(**116 : 159**)	(0 : 163)	(0 : 163)	(0 : 10)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)
WY2010	(0 : 0)	(**127:151**)	(0 : 158)	(0 : 155)	(0 : 9)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)
WY2011	(0 : 0)	(Pass,4)*	(0 : 160)	(0 : 157)	(0 : 8)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)
WY2012	(0 : 0)	(Pass,4)*	(0 : 164)	(**1 : 164**)	(0 : 12)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)	(0 : 0)

Notes:
1st number indicates number of excursions; 2nd number indicates total number of samples collected
CY = calendar year (January–December)
WY = water year (May–April).
* Dissolved oxygen limit was switched from 5 mg/L to site-specific alternative criterion in WY2011.
Bold values indicate excursions from state Class III criteria

Table 4. Excursions from state Class III surface water criteria for individual C-111 EO #9 monitoring sites during Water Year 2012 (May 1, 2011–April 30, 2012).

Area	Structure	Sampling Site	Alkalinity	SSAC Pass/Fail	Specific Conductance	pH	Turbidity	Un-Ionized Ammonia	Iron	Cadmium	Copper	Zinc
Inflow	S332B	S332B	-ND-	Pass	(0 : 53)	**(1 : 53)**	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
		S332B Auto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S332C	S332C	-ND-	Pass	(0 : 53)	(0 : 53)	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
		S332C Auto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S331-173	S331-173	-ND-	-ND-	-ND-	-ND-	(0 : 4)	-ND-	-ND-	-ND-	-ND-	-ND-
	S332D	S332DX	-ND-	Pass	(0 : 54)	(0 : 54)	(0 : 6)	-ND-	-ND-	-ND-	-ND-	-ND-
Interior	C1	CULC1	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	C2	CULC2	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
Diversion	DS1	DS1	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS2	DS2	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS3	DS3	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	DS4	DS4	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
Outflow	BERMB3	BERMB3	-ND-	Pass	(0 : 4)	(0 : 4)	(0 : 2)	-ND-	-ND-	-ND-	-ND-	-ND-
	Totals		-ND-	(Pass,4)	(0 : 164)	**(1 : 164)**	(0 : 12)	-ND-	-ND-	-ND-	-ND-	-ND-

Notes:
1st number in parenthesis indicates number of excursions
2nd number in parenthesis indicates total number of samples collected
Bold numbers indicate excursions from state Class III criteria
-ND- indicates that no data were collected

Dissolved Oxygen

As part of the warm natural water conditions found in South Florida, even unimpacted areas of the Everglades commonly have dissolved oxygen (DO) concentrations below the 5 milligrams per liter (mg/L) standard. Because natural levels commonly fall below the existing standard, the FDEP adopted a site-specific alternative criterion (SSAC) for DO in the EPA that better reflects naturally occurring conditions (see Volume I, Chapter 3A). Dissolved oxygen conditions for surface water discharges were originally assessed against the Class III DO criterion, and are now being assessed against the Everglades DO SSAC (since WY2011) in an attempt to be consistent with application in marsh ecosystems. Because a single-value criterion does not adequately account for the wide-ranging natural daily fluctuations observed in the Everglades marshes, the SSAC provides a mechanism to account for the major factors (e.g., time of day and season) that influence natural background DO variation in the Everglades (Weaver, 2004). The SSAC is based on an algorithm that uses sample collection time and water temperature to model the observed natural sinusoidal diel cycle and seasonal variability. This model provides a lower DO limit (DOL) for an individual monitoring station, and is described by the equation:

$$\text{DOL} = [-\,3.70 - \{1.50 \cdot \text{sine}\,(2\pi/1440 \cdot t_i) - (0.30 \cdot \text{sine}\,[4\pi/1440 \cdot t_i])\} + 1/(0.0683 + 0.00198 \cdot C_i + 5.24 \cdot 10^{-6} \cdot C_i^2)] - 1.1$$

Where:

DOL_i = lower limit for the i^{th} annual DO measurement in milligrams per liter (mg/L)

t_i = sample collection time in minutes (Eastern Standard Time) since midnight of the i^{th} annual DO measurement

C_i = water temperature associated with the i^{th} annual DO measurement in °Celsius (°C)

The SSAC is assessed based on a comparison between the annual average measured DO concentration and the average of the corresponding DO limits specified by the above equation. There were no DO excursions at individual stations during WY2012. Results are provided in **Table 3** and **Table 4**.

Total Dissolved Solids and Dissolved Organic Carbon

Sampling for total dissolved solids (TDS) in groundwater is required quarterly at twelve wells situated near structures S332B, S332C, and S332D. Sampling for dissolved organic carbon (DOC) is required in surface water at S-332DX and S331-S173 on a quarterly basis.

The summary results for groundwater TDS for WY2012 are presented in Attachment D, **Table D-4**. The TDS varied from 176 to 390 mg/L in groundwater samples. The summary results for DOC in WY2012 are presented in Attachment D, **Table D-5**. DOC in the surface water sampled at the inflow structure S332DX ranged from 9.6 to 17 mg/L, and at upstream structure S331-S173, it ranged from 14 to 17.8 mg/L.

Evaluation of Total Phosphorus

C-111 EO #9 established the monitoring schedule shown in Attachment B, **Table B-1** for the collection of TP at C-111 EO #9 structures. Sample collection is accomplished mainly through a grab sample collection program. Grab samples are collected weekly if flowing, otherwise monthly for the inflow structure S332DX, weekly if flowing for S332B and S332C, and biweekly if flowing, otherwise monthly for outflow structure (Berm B3), and event driven, sampled only when a discharge event has occurred, for the diversion structures (DS2 and DS4). Nutrients are the most frequently sampled parameters in this monitoring program.

Table 5. Flow-weighted mean TP concentrations and TP loads of surface water in WY2012.

Type	Structure	Station	Total Flow (acre-feet)	Sample Size (Grab)	Days with Positive Flow	Arithmetic Average (Grab) (µg/L)	Sample Size (Comp)	Sample Type	Samples Collected During Flow	Flow-Weighted Mean Concentration (µg/L)	TP Load (kg)
Inflow	S332B	S332B	64,821	51	179	8.2	23	Auto [1] & Grab [2]	50/74 [3]	9.9	791
	S332C	S332C	82,357	51	175	7.8	24	Auto & Grab	51/75	9.0	911
	S332D	S332DX	65,550	51	168	8.2	49	Auto & Grab	74/100	6.9	557
Diversion	DS1	DS1	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS2	DS2	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS3	DS3	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
	DS4	DS4	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
Outflow	BERMB3	BERMB3	0	4	N/D	63.5	N/D	Auto & Grab	0/4	N/F	N/F

Notes:
[1] Auto indicates that samples were collected by automatic composite samplers
[2] Grab indicates samples collected by grab sampling methodology
[3] 50/74 indicates 50 samples collected during flow events among 74 total collected samples
N/D - No data available
N/F - No flow

During WY2012, auto-samplers (sampling regimes for S-332B, S-332C, and S-332D are described in Attachment D, **Table D-2**) collected TP samples weekly at the inflow structures S-332B, S-332C, and S-332D (water quality id S-332DX) pump stations. As shown in **Table 5**, no samples were collected at the two interior detention areas (CULC1 and CULC2) and four diversion structures (DS1, DS2, DS3, and DS4). Grab sampling is required to be conducted at site BERMB3 on a "biweekly if flowing, otherwise monthly" basis. During the year, 27 biweekly attempts were made to collect samples from Berm B3. Of these, 23 produced no results because water depths did not meet minimum sampling criteria, or were dry. Of the four samples collected, two were analyzed for the full suite of parameters, but four were analyzed for TP only, which follows written and approved sampling procedures concerning low water samples. The TP concentration data collected for all monitoring locations during WY2012 are plotted in time-series and notched-box-and-whisker plots in Attachment E, **Figures E-1** to **E-20**. The plots provide a comparison of TP concentration data to detect changes and trends in TP concentrations at C-111 EO #9 monitoring locations. TP concentrations are reported in ppb (or micrograms per liter [µg/L]) unless otherwise noted. For WY2012, a statistical comparison of TP concentration data for all monitoring locations is presented as notched-box-and-whisker plots in **Figure 13**. This figure represents all samples at inflow structures. Summary statistics of TP data collected for all monitoring locations are presented as a separate table in Attachment D, **Table D-3** (grab and auto-sampler data are reported separately). A discussion of the TP concentration data observed during WY2012 is provided in the following sections.

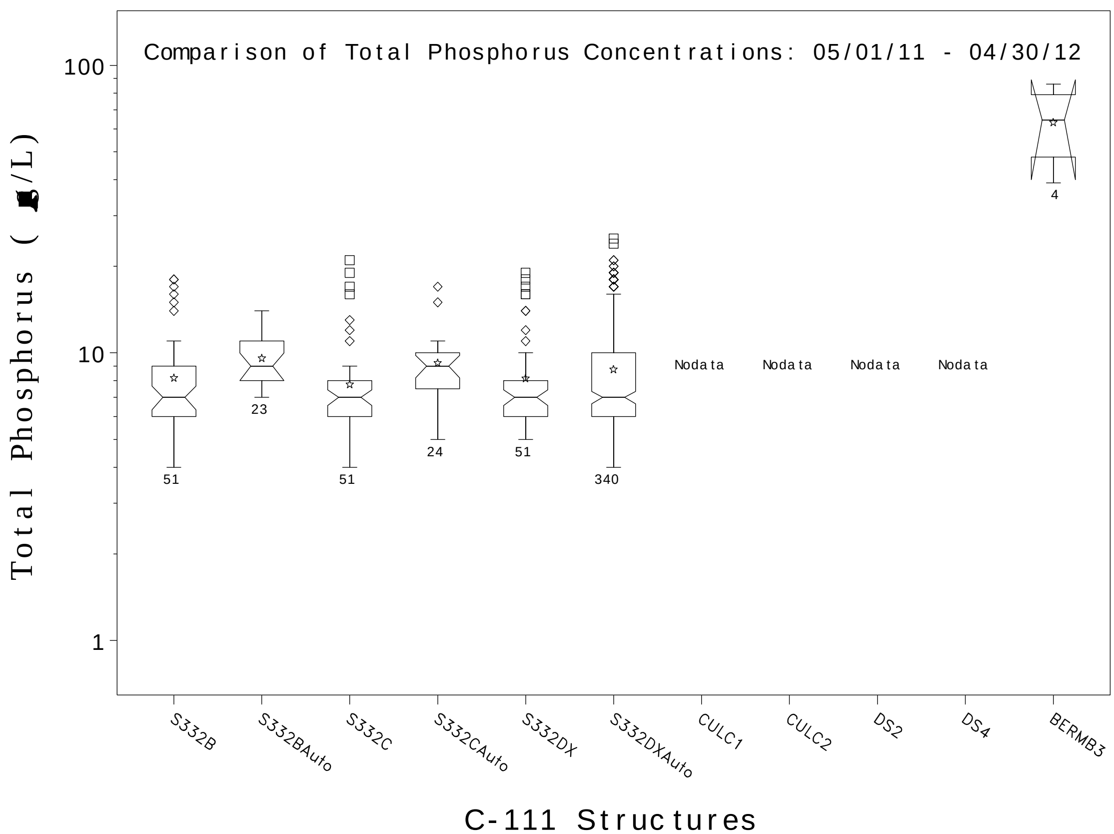


Figure 13. Comparison of TP concentrations for C-111 canal structures.

Inflow Structures

The TP concentrations for the C-111 EO #9 structures discharging directly to the detention areas during WY2012 varied around 10 ppb for all pump stations (**Figure 13**).

As shown in **Table 5**, 74 samples were collected by both grab and auto-samplers, with 50 flow events (a sample was collected when there was flow) at the S-332B site. At the S-332C site, 75 samples were collected by either grab or auto-samplers with 51 flow events. Grab and auto-samplers were used to collect 100 samples at the S-332D pump station (designated water quality station S332DX is at the upstream of S-332D pump station) with 74 flow events.

As shown in **Table D-3** of Attachment D, more than 75 percent of the TP data collected at the S-332B monitoring sites was below 9 ppb for grab and 11 ppb for auto-sampler, with a median value of 7 ppb for grab and 9 ppb for auto-sampler. More than 75 percent of the TP data collected at the S-332C monitoring sites was below 8 ppb (grab) and 10 ppb (auto-sampler), with a median value of 7 ppb for grab and 9 ppb for auto-sampler. Discharge data monitored at pump stations during WY2012 [64,821 acre-feet (ac-ft) for S-332B and 82,357 ac-ft for S-332C] indicate the magnitude and occurrence of flow through the structures. Similar TP concentrations were observed for structure S-332D. More than 75 percent of the TP data collected at the S-332D monitoring sites were below 8 ppb (grab) and 10 ppb (auto-sampler), with median concentrations of 7 ppb for both grab and auto-sampler. During WY2012, structure S-332D discharged 65,550 ac-ft to the detention area.

Interior Structures

Monitoring of TP at interior structures CULC1 and CULC2 was discontinued in WY2007 as a result of a monitoring plan modification approved by FDEP in August 2006.

Diversion Structures

As shown in **Figure 11**, DS2 and DS4 are the only diversion structures that could actually discharge into the ENP. However, no flow occurred at any of the four diversion structures (DS1, DS2, DS3, and DS4), so no samples were collected.

Outflow Structures

BERMB3 is the only surface water outflow structure to the ENP. During WY2012, there was no flow recorded from the detention area to the ENP via the BERMB3 structure. During the year, 27 biweekly attempts were made to collect samples from Berm B3. Of these, 23 produced no samples because water depths did not meet minimum sampling criteria, or were dry. The TP concentration at BERMB3 with a concentration of 63.5 ppb (see **Table 5** and **Figure 13**), which were the highest of the C-111 structures. Sampling disturbance may have caused the high concentration due to shallow water depth. Flow rarely occurs over BERMB3 due to the high seepage rates.

Flow-Weighted Mean Total Phosphorus Concentrations for All Structures

Flow-weighted mean (FWM) TP concentrations were calculated for each structure for WY2012. This analysis is useful for determining whether additional sampling is required during flow events and provides a more accurate depiction of expected concentrations during flow events. The calculation for FWM TP concentrations was accomplished for structures having sufficient TP and flow data for WY2012. The FWM TP concentrations and the annual and quarterly flow volumes for the inflow and outflow structures during WY2012 are provided in Attachment B, **Table B-2**.

Table 5 presents the results for the FWM TP concentrations at inflow sites during WY2012. The FWM TP concentration for all the inflow structures during WY2012 were less than 10 ppb with 9.9 ppb at the S-332B, 9.0 ppb at the S-332C, and 6.9 ppb at the S-332D pump stations. There was no flow at interior, diversion, and outflow structures; therefore, FWM TP concentrations could not be calculated for those sites.

Evaluation of Total Nitrogen

During WY2012, auto-samplers collected total nitrogen (TN) samples weekly at the S-332B and S-332C pump structures. Deployment of auto-samplers at these locations was previously identified as an improvement in the monitoring program for collecting TN data at inflow structures. Weekly auto-sampler (time proportional) collection and biweekly grab samples at the respective monitoring locations (S-332B, S-332C, and S-332D) were initiated in 2003 and flow proportional auto-samplers were used later; a discrete time proportional auto-sampler was installed at S-332DX in October 2, 2007, as shown in **Table C-2**. Auto-samplers collected samples at the S-332D structures in the C-111 basin that discharge water into the S-332D detention area east of the ENP.

The TN concentration data collected for all monitoring locations during WY2012 are plotted in time-series and notched-box-and-whisker plots in Attachment E, **Figures E-21** through **E-38.** The plots provide a comparison of TN concentration data to detect changes and trends in TN concentrations at the C-111 EO #9 monitoring locations. TN concentrations are reported in parts per million (ppm), or milligrams per liter (mg/L), unless otherwise noted.

For WY2012, a statistical comparison of TN concentration data for all monitoring locations is presented as notched-box-and-whisker plots in **Figure 14**. The figure represents inflow. Summary statistics of TN data collected for all monitoring locations are presented as a separate table in Attachment D, **Table D-3** (grab and auto-sampler data are reported separately). A discussion of the TN concentration data observed during WY2012 is provided in the following sections.

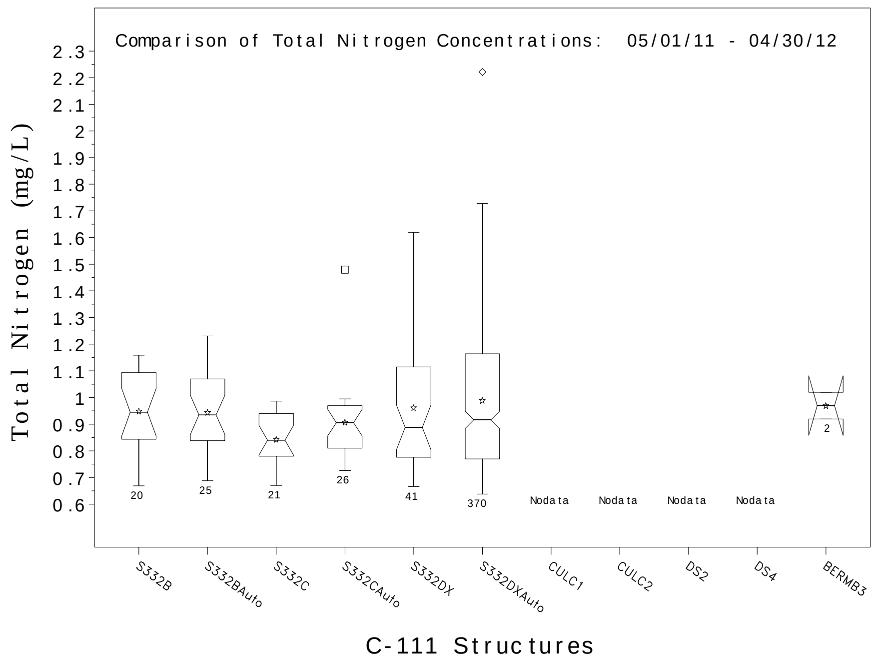


Figure 14. Comparison of total nitrogen (TN) concentrations for C-111 canal structures.

Inflow Structures

There was a similar average TN concentration in grab samples for all inflow structures (0.940 mg/L for S-332B, 0.845 mg/L for S-332C, and 0.992 mg/L for S-332D) discharging into the detention area during WY2012 (**Table 6** and **Figure 14**). As shown in **Table D-3** of Attachment D, more than 75 percent of the TN data collected at the S-332B monitoring site was below 1.095 mg/L (grab) and 1.070 mg/L (auto-sampler), with median values of 0.945 mg/L (grab) and 0.935 mg/L (auto-sampler). More than 75 percent of the TN data collected at the S-332C monitoring site was below 0.940 mg/L (grab) and 0.970 mg/L (auto-sampler), with median values of 0.840 mg/L (grab) and 0.906 mg/L (auto-sampler). More than 75 percent of the TN data collected at the S-332D monitoring site was below 1.115 mg/L (grab) and 1.164 mg/L (auto-sampler), with median values of 0.888 mg/L (grab) and 0.917 mg/L (auto-sampler).

Interior Structures

Monitoring of TN at interior structures CULC1 and CULC2 was discontinued in WY2007 as a result of a monitoring plan modification approved by FDEP in August 2006...

Table 6. Flow-weighted mean TN concentrations and TN loads of surface water in WY2012.

Type	Structure	Station ID	Total Flow Volume (acre-feet)	Sample Size (Grab)	Days with Positive Flow	Arithmetic Average (Grab) (mg/L)	Sample Size (Comp)	Sample Type	Samples Collected During Flow	Flow-Weighted Mean Concentration (mg/L)	TN Load (kg)
Inflow	S332B	S332B	64,821	13	179	0.940	17	Auto [3] & Grab [2]	30/30 [5]	1.009	80,648
	S332C	S332C	82,357	14	175	0.845	17	Auto [3] & Grab [2]	31/31	0.918	93,296
	S332D	S332DX	65,550	33	168	0.992	44	Auto [3] & Grab [2]	61/77	0.822	66,437
Diversion	DS1	DS1	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS2	DS2	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS3	DS3	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
	DS4	DS4	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
Outflow	BERMB3	BERMB3	0	2	N/D	0.973	N/D	Auto [3] & Grab [2]	0/2	N/F	N/F

Notes:
[1] N/D - No data available
[2] Grab - Samples were collected by grab sampling methodology
[3] Auto - Samples were collected by automatic composite samplers
[4] N/F - No flow
[5] 30/30 - Thirty samples were collected during flow events among thirty total collected samples

Diversion Structures

As shown in **Table 6**, there was no flow for the four diversion structures (DS1, DS2, DS3, and DS4). As a result, no samples were collected from diversion structures during WY2012.

Outflow Structures

BERMB3 is the only outflow structure to the ENP. During WY2012, there were no discharges from the detention area to the ENP through the BERMB3 structure. During the year, 27 biweekly attempts were made to collect samples from Berm B3. Of these, 4 samples were collected (when water depths met the minimum sampling criteria). However, only 2 samples had sufficient volume of water to analyze for TN These 2 samples had an average TN concentration of 0.973 mg/L (**Table 6)**.

Flow-Weighted Mean TN Concentrations for All Structures

Flow-weighted mean TN concentrations were calculated for all inflow structures during WY2012. The analysis is useful in determining whether additional sampling is required during flow events and provides a more accurate depiction of expected concentrations during flow events. The calculation for FWM TN concentrations was accomplished for structures having sufficient TN and flow data for WY2012. A detailed analysis of WY2012 FWM TN concentrations for each inflow structure is shown in **Table 6**. Similar FWM TN concentrations were observed at all inflow structures (1.009 mg/L for S-332B, 0.918 mg/L for S-332C, and 0.822 mg/L for S-332D pump station). The FWM TN concentration and monthly and quarterly flow volumes for the inflow, interior, diversion, and outflow structures during WY2012 are provided in Attachment B, **Table B-3**.

GROUNDWATER QUALITY

The groundwater monitoring sites are mapped in **Figure 15** with results shown in **Table 7**. TP concentrations were less than 10 ppb at all 12 groundwater wells except for S332CED and S332CES, where the TP concentration was ranked as a concern at S332CES (48 ppb). However, this value is an anomaly. The high TP levels at S-332CED were investigated, and the well was redeveloped in December 2008 and March 2009. Field investigations indicate S332CED is the deepest well (185 ft) among all of the wells sampled. The high TP concentration most likely results from mobilization of deep pre-existing phosphorus-rich geological strata. The average concentration of S332CES was 11 ppb (slightly higher than 10 ppb), but this site is on the east side of the detention area and thus is not a concern for the Park. The TP concentrations in the other shallow wells east of the detention areas (S332BES, S332BED, S332DES, and S332DED) are considerably lower than S332CED, and groundwater flows east when the detention areas have flow. The low TP concentration in shallow wells indicates there should be no TP concern for groundwater in normal operation unless the water is pumped from the deep layer (185 ft). As shown in **Table 8**, TN concentrations in groundwater ranged from 0.110 to 0.885 mg/L. TN concentrations are less than 1 mg/L, which is similar to or slightly lower than the TN in surface water (from 0.845 to 0.992 mg/L, as shown in **Table 6**). Water quality data for WY2012 will be available on request.

The TP and TN mass balances (**Tables 5** through **8**) were estimated based on water balance and concentrations of inflows and groundwater wells. The following assumptions were made for water balance: negligible storage exists in impoundments; rainfall is equal to or exceeds evapotranspiration; and net inflow (all inflows minus outflows) provides a reasonable estimate of seepage. The following assumptions were made for mass balance:

- Rainfall is equal to or exceeds evapotranspiration

- Rainfall TP is offset by TP lost through evapotranspiration (i.e., rainfall TP is considered neutral)
- Net inflow (all inflows minus outflows) is lost to seepage to groundwater

As shown in **Table 5**, the flow pumped into the detention areas contained 791 kilograms (kg) of TP at S-332B, 911 kg of TP at S-332C, and 557 kg of TP at S-332D. Since no measurable surface water discharge occurred during this monitoring period, none of this load left the detention areas through surface flows. With the notable exception of the TP measured at S332CED, the groundwater wells located on both the western and eastern sides of the detention areas have average water quality similar to inflow concentrations. As shown in **Tables 5** and **7**, the average surface water inflow (pumped) TP concentrations ranged from 7.8 to 8.2 ppb, whereas the average groundwater concentration in the western wells ranged from 4.5 to 6.3 ppb, and the average concentration in the eastern wells, with the notable exception of S332CED, ranged from 4.3 to 11 ppb. It is impossible to ascertain with any certainty that this slight improvement is due to treatment provided by the detention area. Other factors, such as dilution by rainfall and the heterogeneous nature of flow in the highly transmissive layers of the surficial aquifer system, limit the conclusions that can be made based on the water quality data obtained from the monitor wells. In addition, to calculate loading to the ENP, it would be necessary to quantify how much of the seepage flows west.

As shown in **Table 6**, the inflow (pumped) TN load was 43,821 kg at S-332B, 52,265 kg at S-332C, and 34,810 kg at S-332D. The average inflow (pumped) TN concentrations ranged from 0.845 to 0.992 mg/L, whereas the average concentration in the western wells ranged from 0.650 to 0.885 mg/L, and the average concentration in the eastern wells ranged from 0.110 to 0.827 mg/L (**Table 8**). The TN concentrations in wells were generally slightly lower than TN concentrations of inflow structures.

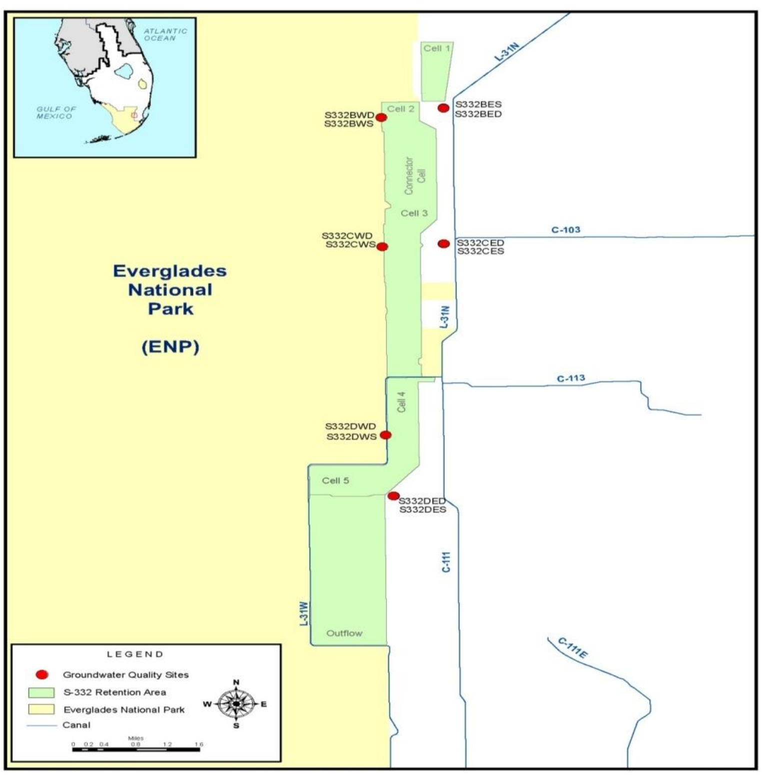


Figure 15. Groundwater monitoring locations and numbering for S-332B, S-332C, and S-332D.

Table 7. Average TP concentrations and TP loads of groundwater during WY2012.

Structure	Station	Total Flow (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab) (µg/L or ppb)	Sample Type	TP Load (kg)
S332B	S332BED[1]	64,821	4	7.3	Grab [2]	341
	S332BES		4	7.0	Grab [2]	
	S332BWD		4	6.3	Grab [2]	
	S332BWS		4	5.5	Grab [2]	
S332C	S332CED	82,357	4	48.0	Grab [2]	511
	S332CES		4	11.0	Grab [2]	
	S332CWD		4	6.0	Grab [2]	
	S332CWS		4	6.0	Grab [2]	
S332D	S332DED	65,550	4	5.3	Grab [2]	252
	S332DES		4	4.3	Grab [2]	
	S332DWD		4	5.0	Grab [2]	
	S332DWS		4	4.5	Grab [2]	

Notes:

[1] S332BED: S332B = station name; E = east; W = west; D = deep; S = shallow
[2] Grab indicates samples collected by grab sampling methodology

The following assumptions were made for water balance:
a) negligible storage in impoundments
b) rainfall and evapotranspiration are equal
c) net inflow (all inflows minus outflows) is lost to seepage to groundwater

The following assumptions were made for mass balance:
a) rainfall and evapotranspiration are equal
b) net inflow (all inflows minus outflows) is lost to seepage to groundwater
c) net mass balances (all inflows minus outflows, minus lost to seepage to groundwater) are due to sediment release or sediment adsorption

Table 8. Average TN concentrations and TN loads of groundwater during WY2012.

Structure	Station	Total Flow (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab) (µg/L or ppb)	Sample Type	TN Load (kg)
S332B	S332BED[1]	64,821	3	0.827	Grab [2]	43,821
	S332BES		2	0.790	Grab [2]	
	S332BWD		2	0.885	Grab [2]	
	S332BWS		2	0.837	Grab [2]	
S332C	S332CED	82,357	2	0.110	Grab [2]	52,265
	S332CES		2	0.795	Grab [2]	
	S332CWD		2	0.761	Grab [2]	
	S332CWS		2	0.795	Grab [2]	
S332D	S332DED	65,550	2	0.682	Grab [2]	34,810
	S332DES		2	0.615	Grab [2]	
	S332DWD		2	0.676	Grab [2]	
	S332DWS		2	0.650	Grab [2]	

Notes:

[1] S332BED: S332B = station name; E = east; W = west; D = deep; S = shallow
[2] Grab indicates samples collected by grab sampling methodology

The following assumptions were made for water balance:
a) negligible storage in impoundments
b) rainfall and evapotranspiration are equal
c) net inflow (all inflows minus outflows) is lost to seepage to groundwater

The following assumptions were made for mass balance:
a) rainfall and evapotranspiration are equal
b) net inflow (all inflows minus outflows) is lost to seepage to groundwater
c) net mass balances (all inflows minus outflows, minus lost to seepage to groundwater) are due to sediment release or sediment adsorption

PESTICIDE MONITORING

A monitoring modification was approved by FDEP in September 2007, to eliminate pesticide monitoring at S-332B and S-332C sites and use S331-173 as a surrogate pesticide monitoring site. Quarterly monitoring of pesticides is required at S331-173 and S332DX. The results of the sampling events at these sites for WY2012 are presented in **Table 9**.

To evaluate the potential impacts on aquatic life, the observed concentration is compared to the appropriate criterion outlined in F.A.C. Section 62-302.530. If a pesticide compound is not specifically listed, acute and chronic toxicity criterion can be calculated as one-third and one-twentieth, respectively, of the amount lethal to 50 percent of the test organisms in 96 hours, using the lowest technical grade EC50 or LC50 reported in the summarized literature for the species significant to the indigenous aquatic community (F.A.C. Section 62-302.200) (**Table 10**).

The draft atrazine ambient aquatic life water quality criteria identify a one-hour average concentration that does not exceed 1,500 μg/L more than once every three years on the average (U.S. Environmental Protection Agency, 2003). The highest atrazine surface water concentration detected (0.053 μg/L) should not have an acute or chronic detrimental impact on fish or invertebrates (**Table 10**).

Table 9. Quarterly pesticide detections (μg/L) for WY2012.

Sampling Date	Flow	Site	Compound: Atrazine
7/11/2011	No	S332DX	0.051 I
	No	S331	0.053*
10/24/2011	Yes	S332DX	BDL
	Yes	S331	BDL
2/9/2012	No	S332DX	0.021 I
	Yes	S331	0.038 I

BDL: below method detection limit

* Value is the average of replicate samples

I: Value reported is less than the practical quantitation limit, and greater than or equal to the method detection limit

Table 10. Toxicity of pesticides detected to freshwater aquatic invertebrates and fishes (µg/L).

Common Name	48 hr EC_{50}			96 hr LC_{50}			96 hr LC_{50}			96 hr LC_{50}		
	Water flea *(Daphnia magna)*	**Acute Toxicity***	**Chronic Toxicity***	**Bluegill** *(Lepomis macrochirus)*	**Acute Toxicity***	**Chronic Toxicity***	**Largemouth Bass** *(Micropterus salmoides)*	**Acute Toxicity***	**Chronic Toxicity***	**Channel Catfish** *(Ictalurus punctatus)*	**Acute Toxicity***	**Chronic Toxicity***
Atrazine	6,900 (1)	2,300	345	16,000 (2)	5,333	800	-	-	-	7,600 (2)	2,533	380

(*) Florida Administrative Code (FAC) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC50 is the lowest value which has been determined for a species significant to the indigenous aquatic community.

(1) Hartley, D. and H. Kidd. (Eds.) (1987). The Agrochemicals Handbook. Second Edition, The Royal Society of Chemistry. Nottingham, England.

(2) U.S. Environmental Protection Agency (1991) Pesticide Ecological Effects Database, Ecological Effects Branch, Office of Pesticide Programs, Washington, DC.

MERCURY MONITORING

During the course of the C-111 Canal Project, THg surface water levels were well below the 12 nanograms per liter (ng/L) Florida Class III numerical water quality standard. In WY2012, mosquitofish samples were collected from the interior, downstream, and diversion sites (**Figure 16**). THg levels from the three sites were well below the Southern Everglades 75th percentile concentration of 0.08 milligrams per kilogram (mg/kg) for the period of record up to 2012 and the USEPA trophic level III fish protection criteria of 0.077 mg/kg, therefore demonstrating no threat to piscivorous avian and mammalian wildlife. Mercury levels in C-111 mosquitofish are below average levels found in several Stormwater Treatment Areas and all downstream Everglades monitoring locations (refer to 2012 SFER – Volume I, Appendix 3B-1 and 5-5). All sites in WY2012 display lower THg levels than the previous two water years.

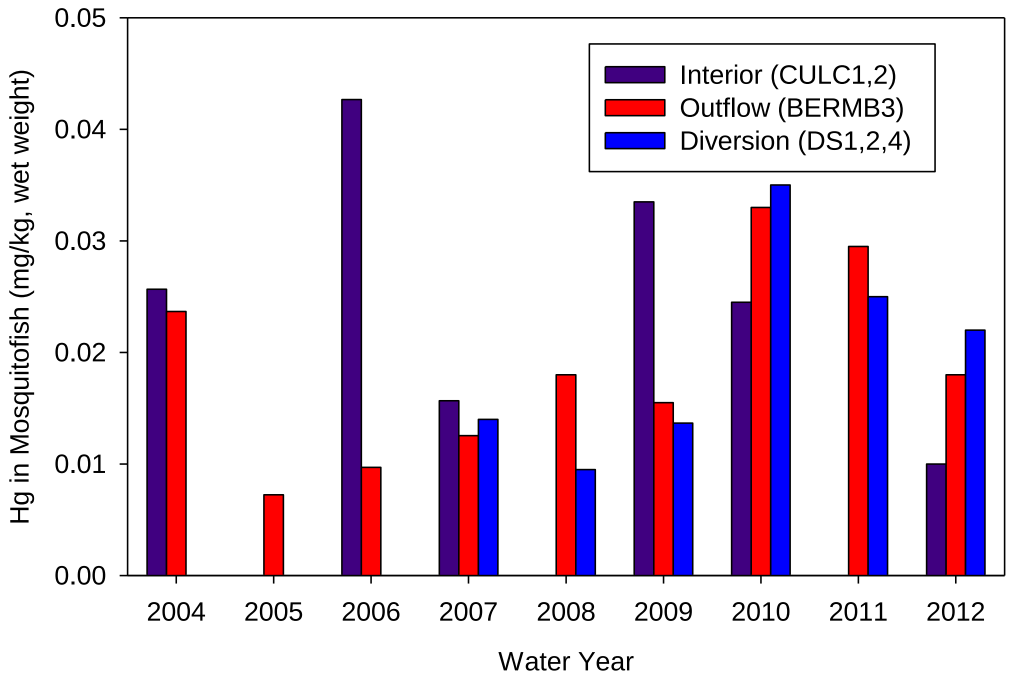


Figure 16. Total mercury (THg) in mosquitofish from the C-111 Canal Project. Missing bars indicate no fish collection.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented for the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow (Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242) in this report.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(All references are to Volume III, unless noted)*			
				Narrative (page #'s)	Figure	Table	Attachment
25(a)	Monitoring activities for operation of S-332B, S-332C, and S-332D pump stations and appurtenant structures; reports and data submitted to the Program Coordination and Regulation Section	Operation	Monitoring and reports completed as required	All	All	All	All
25(b)*	Annual operational status report on flows at inflow and outflow structures, relative to canal water levels, including details on overflow events	Operation	Annual report completed and submitted as required	All		B-2, B-3	B, G
25(c)	Biological monitoring, with reports and data made available at the Corps' FTP site	Construction	N/A in Operation Phase				
25(d)	Turbidity monitoring	Construction	N/A in Operation Phase				
25(e)	Manatee protection measures	Construction	N/A in Operation Phase				
25(f)	Stormwater pollution prevention plan prior to construction of the C-111 accelerated project features	Construction	N/A in Operation Phase				
25(g)	Complete construction of Option 2 of proposed modified weir scenarios or Land Swap Detention Areas by end of 2005 dry season	Construction	N/A in Operation Phase				

** This condition was modified in a letter from the FDEP to the SFWMD on January 28, 2008.*

Attachment B: Interim Operational Plan Water Quality Sampling Sites, Monitoring Schedule, Flow Volumes and Flow-Weighted Mean Concentrations for Water Year 2012

Shi Kui Xue

Table B-1. Water quality monitoring schedule reflecting modification on January 28, 2008 for the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) discharge structures and associated monitoring locations.

Area	EO #9 Permit Structure	Water Quality Sampling Site	Water Quality Monitoring Schedule							
			Physical	Nutrients	Major Ions	Trace Metals	Total Hg	THG in Bass	THg in Mosquitofish	Pesticides
Inflow	S332 B	S332 B	BW	BW,WF (autosampler)	QTR	QTR	QTR			QTR
	S332C	S332C	BW		QTR	QTR	QTR			QTR
	S332D	S332DX	BW		QTR	QTR	QTR			QTR
Interior	C1	CULC1							Annually	
	C2	CULC2							Annually	
Outflow	BERMB3	BERMB3	BW	BW,WF (autosampler)	QTR	QTR	QTR		Annually	QTR
Diversion	DS1	DS1	Event	Event	Event		Event		Annually	Event
	DS2	DS2	Event	Event	Event		Event		Annually	Event
	DS3	DS3	Event	Event	Event		Event			Event
	DS4	DS4	Event	Event	Event		Event		Annually	Event
Groundwater	S332B	S332BED	QTR	QTR	QTR	QTR				SA
		S332BES	QTR	QTR	QTR	QTR				SA
		S332BWD	QTR	QTR	QTR	QTR				SA
		S332BWS	QTR	QTR	QTR	QTR				SA
	S332C	S332CED	QTR	QTR	QTR	QTR				SA
		S332CES	QTR	QTR	QTR	QTR				SA
		S332CWD	QTR	QTR	QTR	QTR				SA
		S332CWS	QTR	QTR	QTR	QTR				SA
	S332D	S332DED	QTR	QTR	QTR	QTR				SA
		S332DES	QTR	QTR	QTR	QTR				SA
		S332DWD	QTR	QTR	QTR	QTR				SA
		S332DWS	QTR	QTR	QTR	QTR				SA

Notes:
BW = Biweekly
WF = Weekly, if flowing
QTR = Quarterly
SA = Semiannually

Table B-2. Flow volume and average TP concentrations for the IOP for Protection of the CSSS structures during WY2012.

Type	EO #9 Permit Structure	Water Quality Sampling Site	Flow		Quarterly Flow				Total Flow Volume (acre-ft)	Average TP Conc. (ppb) by Quarter				TP Load (kg) by Quarter				Total Load (kg)
			Station	DBKEY	1st	2nd	3rd	4th		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
Inflow	S332B	S332B	S332B	TB064	39	32,840	30,955	988	64,821	8	10	10	10	0	392	388	12	791
	S332C	S332C	S332C	UT724	19	40,351	40,958	1,029	82,357	7	8	9	12	0	417	480	15	911
	S332D	S332D	S332D	TA413	143	32,661	32,488	257	65,550	9	7	7	8	2	273	280	2	557
Interior	C1	CULC1			NPF [3]	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	C2	CULC2			NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Diversion	DS1	DS1	DS1		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS2	DS2	DS2		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS3	DS3	DS3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS4	DS4	DS4		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Outflow	BERMB3	BERMB3	BERMB3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	48.0	79.0	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a [2]	n/a	n/a	n/a	n/a	n/a	64,821	7	7	7	8	n/a	n/a	n/a	n/a	341
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		6	6	7	9	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		6	7	6	6	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		6	5	5	6	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	82,357	54	45	34	59	n/a	n/a	n/a	n/a	511
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		12	13	9	10	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		5	7	6	6	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		6	6	6	6	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	65,550	6	5	5	5	n/a	n/a	n/a	n/a	252
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		2	6	5	4	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		7	5	4	4	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		5	6	3	4	n/a	n/a	n/a	n/a	

Notes:

1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location.
2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information.
3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated.
4) M-data were missing

Table B-3. Flow volume and average TN concentrations for IOP for Protection of the CSSS structures during WY2012.

Type	EO #9 Permit Structure	Water Quality Sampling Site	Flow		Quarterly Flow				Total Flow Volume (acre-ft)	Average TN Conc. (ppb) by Quarter				TN Load (kg) by Quarter				Total Load (kg)
			Station	DBKEY	1st	2nd	3rd	4th		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
Inflow	S332B	S332B	S332B	TB064	39	32,840	30,955	988	64,821	0.874	0.907	1.118	0.889	42	36788	42733	1084	80,648
	S332C	S332C	S332C	UT724	19	40,351	40,958	1,029	82,357	0.700	0.880	0.956	0.868	16	43826	48351	1103	93,296
	S332D	S332D	S332D	TA413	143	32,661	32,488	257	65,550	0.755	0.772	0.869	0.985	134	31142	34849	313	66,437
Interior	C1	CULC1			NPF	NPF	NPF	NPF	NPF	1.905	NPF	0.560	NPF	NPF	NPF	NPF	NPF	NPF
	C2	CULC2			NPF [2]	NPF	NPF	NPF	NPF	0.870	NPF	0.588	NPF	NPF	NPF	NPF	NPF	NPF
Diversion	DS1	DS1	DS1		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS2	DS2	DS2		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS3	DS3	DS3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
	DS4	DS4	DS4		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Outflow	BERMB3	BERMB3	BERMB3	n/a	NPF	NPF	NPF	NPF	NPF	NPF	0.973	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a	n/a	n/a	n/a	n/a	n/a	64,821	0.925	0.765	0.791	n/a	n/a	n/a	n/a	n/a	43,776
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		0.885	0.695	n/a	n/a	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		0.925	0.845	n/a	n/a	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		0.895	0.778	n/a	n/a	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	82,357	0.115	0.105	n/a	n/a	n/a	n/a	n/a	n/a	52,265
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		0.805	0.785	n/a	n/a	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		0.786	0.735	n/a	n/a	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		0.795	0.795	n/a	n/a	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	65,550	0.669	0.695	n/a	n/a	n/a	n/a	n/a	n/a	34,810
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		0.625	0.605	n/a	n/a	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		0.646	0.705	n/a	n/a	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		0.695	0.605	n/a	n/a	n/a	n/a	n/a	n/a	

Notes:

1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location.
2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information.
3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated.
4) M-data were missing

Attachment C: Time-Series and Box Plots for Water Quality Monitoring Data Exhibiting Excursions from Class III Numeric Standards for Water Year 2012

Shi Kui Xue and Steven Hill

This attachment corresponds to the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) water quality monitoring sites exhibiting excursions during Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). The C-111 Canal Project's EO #9 structure locations are depicted in **Figure 11**. Additionally, the graphs are identified by the monitoring site name. In most cases, the monitoring site name corresponds to the structure. If the monitoring site is a surrogate location for a structure, then the structure name(s) is/are shown in parentheses below the monitoring site name. There was one pH (at S332B) excursion for WY2012 for all water quality parameters as showed in **Figure C-1** and **Figure C-2** in this attachment.

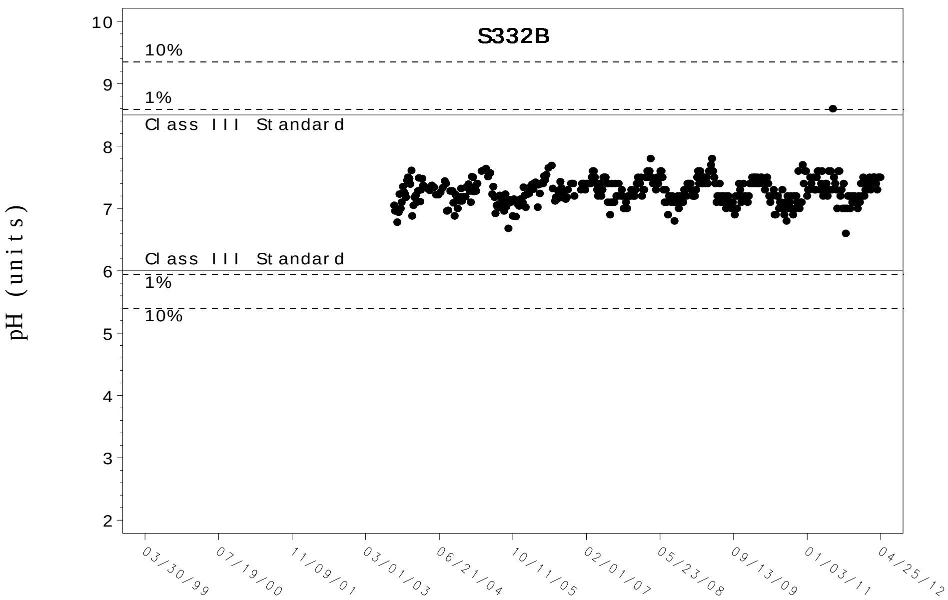

Figure C-1. pH plot at S-332B.

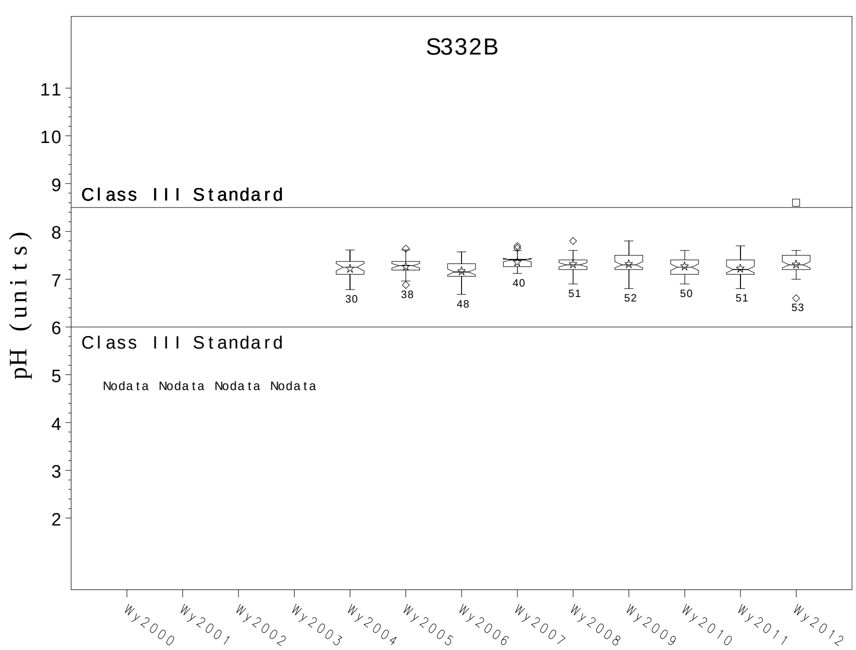

Figure C-2. pH notched-box-and-whisker plot at S-332B.

Attachment D: Summary Statistics of C-111 Water Quality Monitoring Data for Water Year 2012

Shi Kui Xue and Steven Hill

Summary statistics are tabulated in **Table D-3** of this attachment for all parameters collected during WY2012 at the IOP for Protection of the CSSS water quality monitoring sites. **Table D-1** presents the water quality parameters associated with the summary statistics and their associated Florida Class III Fresh Surface Water Criteria [Chapter 62-302.530, Florida Administrative Code (F.A.C.)]. Additionally, the parameter summary statistics shown in **Table D-3** are sequenced according to the order shown in **Table D-1**. The monitoring sites are sequenced in the order shown in **Table D-2**. The C-111 EO #9 structure locations are depicted in **Figure 1**. **Table D-4** summarizes data of total dissolved solids and **Table D-5** summarizes data of dissolved organic carbon.

Table D-1. Class III criteria reference table for surface water quality parameters presented in summary statistics on **Table C-3**.

Parameter	Abbreviated Name	Units	SFWMD Lab Number	Class III Criteria Predominantly Fresh Surface Waters Section 62-302.530, F.A.C.
		PHYSICAL		
Dissolved Oxygen	DO	mg/L	8	Site-specific alternative criterion (SSAC).
Specific Conductance (Field)	FLDCOND	µmhos/cm	9	Not greater than 50% above background or 1,275 µmhos/cm, whichever is greater
pH (Field)	PH	units	10	Not less than 6.0 or greater than 8.5
Turbidity	TURBIDITY	ntu	12	Less than or equal to 29 NTU above natural background
Total Suspended Solids	TSS	mg/L	16	None
Color	COLOR	units	13	None
Hardness	HARDNESS	mg/L as $CaCO_3$	35	None
Temperature	TEMP	centigrade	7	None
Alkalinity	ALKALINITY	mg/L	67	Not less than 20 mg/L
		NUTRIENTS		
Total Nitrogen	TN	mg N/L	80	narrative criteria
Nitrite + Nitrate	NOX	mg N/L	18;180	narrative criteria
Nitrite	NO2	mg N/L	19	narrative criteria
Nitrate	NO3	mg N/L	78	narrative criteria
Ammonium	NH4	mg N/L	182	narrative criteria
Un-Ionized Ammonia	UN-IONIZED AMMONIA	mg/L as NH_3	NONE	Less than or equal to 0.02 mg/L
Total Kjeldahl Nitrogen	TKN	mg N/L	21	narrative criteria
Ortho-Phosphorus	OPO4	mg P/L	23	narrative criteria
Total Phosphorus	TP	mg P/L	25	narrative criteria
		MAJOR IONS		
Dissolved Calcium	DIS. CA	mg/L	30	None
Dissolved Potassium	DIS. K	mg/L	29	None
Dissolved Magnesium	DIS. MG	mg/L	31	None
Dissolved Sodium	DIS. NA	mg/L	28	None
Dissolved Silica	DIS. SILICA	mg/L	27	None
Total Sulfate	TOT. SO4	mg/L	33	None
Total Chlorides	TOT. CL	mg/L	32	None
		TRACE ELEMENTS		
Total Cadmium	TOT. CD	µg/L	103	Less than or equal to calculated value using: $e^{(0.7852[\ln(Hardness)-3.49])}$ µg/L
Total Copper	TOT. CU	µg/L	104	Less than or equal to calculated value using: $e^{(0.8545[\ln(Hardness)-1.702])}$ µg/L
Total Mercury	TOT. HG	µg/L	102	Less than or equal to .012 µg/L
Total Zinc	TOT. ZN	µg/L	105	Less than or equal to calculated value using: $e^{(0.8473[\ln(Hardness)+0.884])}$ µg/L
Total Iron	TOT. FE	mg/L	177	Less than or equal to 1.0 mg/L

Table D-2. Reference table for cross-referencing water quality monitoring sites with C-111 Canal Project's Emergency Order #9 (C-111 EO #9) discharge structures and the monitoring data summary statistics shown in **Table C-3.**

Structure Category	Emergency Order #9 Permit Structure	Water Quality Sampling Site	Total Depth (feet)	Comments
Inflow	S332B	S332B	Surface	Weekly time composite auto-sampler was installed in 2003, 100 ml sample was drawn every 3 hours, changed from time proportional to flow proportional with triggering flow volume of 1.2 million cubic feet on 3/1/05
	S332C	S332C	Surface	Weekly time composite auto-sampler was installed in 2003; 100 ml sample was drawn every 3 hours, changed from time proportional to flow proportional with triggering flow volume of 0.906 million cubic feet on 5/18/05.
	S332D	S332D, S332DAS and S332DX	Surface	Auto-sampler was installed in 2003, S332DAS changed from time to flow proportional with triggering flow volume of 1.7 million cubic feet on 4/16/03, A new water quality station id S332DX was used since 10/2/2007 for both auto (discrete time proportional) and grab sample.
Interior	C1	CULC1	Surface	No sample during the first quarter
	C2	CULC2	Surface	No sample during the first quarter
Diversion	DS1	DS1	Surface	No sample during the first quarter
	DS2	DS2	Surface	No sample during the first quarter
	DS3	DS3	Surface	No sample during the first quarter
	DS4	DS4	Surface	No sample during the first quarter
Outflow	BERMB3	BERMB3	Surface	Auto-sampler was installed in 2003, and has not been activated because of no flow
Groundwater	S332B	S332BED	18	S-332 B East Deep
		S332BES	11	S-332B East Shallow
		S332BWD	14.4	S-332B West Deep
		S332BWS	11.8	S-332B West Shallow
	S332C	S332CED	180.1	S-332 C East Deep
		S332CES	19.5	S-332C East Shallow
		S332CWD	53.5	S-332C West Deep
		S332CWS	26.6	S-332C West Shallow
	S332D	S332DED	45	S-332D East Deep
		S332DES	17.5	S-332D East Shallow
		S332DWD	25.3	S-332D West Deep
		S332DWS	17.2	S-332D West Shallow

Note: "Surface" water grab samples were collected at a depth of 0.5 meters below water surface. A water quality sampling site is located on upstream side of the structure unless otherwise noted with different representative sampling location.

Table D-3. Summary statistics of IOP for Protection of the CSSS water quality monitoring data (physical parameters, nutrients, major ions and trace metals) collected during WY2012.

Station	Test Name	Units	Test Number	Period of Record	# of Samples	Mean	STD	Min	Q25	Median	Q75	Max	# Below Detection Limit	# of Excursions	% Excursions
S332B	DIS. CA	mg/L	30	15AUG2011 - 30APR2012	20	76.500	5.684	67.400	72.900	75.100	81.100	86.600	0	0	0.00%
S332B	DIS. K	mg/L	29	15AUG2011 - 30APR2012	20	2.610	0.259	2.300	2.400	2.600	2.850	3.100	0	0	0.00%
S332B	DIS. MG	mg/L	31	15AUG2011 - 30APR2012	20	8.150	0.451	7.200	7.800	8.050	8.450	9.000	0	0	0.00%
S332B	DIS. NA	mg/L	28	15AUG2011 - 30APR2012	20	30.435	1.268	27.800	29.600	30.350	31.600	33.100	0	0	0.00%
S332B	DO	mg/L	8	02MAY2011 - 30APR2012	51	3.367	1.446	1.120	2.250	3.300	4.600	6.310	0	0	0.00%
S332B	FLDCOND.	UMHOS/CM	9	02MAY2011 - 30APR2012	53	597.434	57.833	531.000	564.000	583.000	604.000	802.000	0	0	0.00%
S332B	HARDNESS	mg/L CACO3	35	15AUG2011 - 30APR2012	20	224.615	13.883	203.100	213.250	220.250	235.050	252.700	0	0	0.00%
S332B	NOX	mg N/L	18;180	15AUG2011 - 30APR2012	13	0.040	0.019	0.014	0.031	0.038	0.046	0.089	0	0	0.00%
S332B	OPO4	mg P/L	23	15AUG2011 - 30APR2012	20	0.002	0.000	<0.002	<0.002	<0.002	<0.002	<0.002	20	0	0.00%
S332B	PH	UNITS	10	02MAY2011 - 30APR2012	53	7.319	0.270	6.600	7.200	7.300	7.500	8.600	0	0	0.00%
S332B	TEMP	CENT	7	02MAY2011 - 30APR2012	53	25.604	2.336	20.600	23.900	25.300	27.500	30.500	0	0	0.00%
S332B	TKN	mg N/L	21	15AUG2011 - 30APR2012	20	0.923	0.163	0.640	0.800	0.945	1.080	1.120	0	0	0.00%
S332B	TN	mg N/L	80	15AUG2011 - 30APR2012	20	0.949	0.159	0.669	0.844	0.945	1.095	1.159	0	0	0.00%
S332B	TOT. CL	mg/L	32	15AUG2011 - 30APR2012	20	47.615	1.966	44.600	46.050	47.100	48.900	52.000	0	0	0.00%
S332B	TOTAL DEPTH	METERS	99	31OCT2011 - 31OCT2011	1	0.500		0.500	0.500	0.500	0.500	0.500	0	0	0.00%
S332B	TP	mg P/L	25	02MAY2011 - 30APR2012	51	0.008	0.003	0.004	0.006	0.007	0.009	0.018	0	0	0.00%
S332B	TSS	mg/L	16	15AUG2011 - 30APR2012	20	3.000	0.000	<3	<3	<3	<3	<3	20	0	0.00%
S332BAuto	NOX	mg N/L	18;180	15AUG2011 - 30APR2012	17	0.040	0.013	0.026	0.031	0.036	0.041	0.068	0	0	0.00%
S332BAuto	TKN	mg N/L	21	15AUG2011 - 30APR2012	25	0.917	0.156	0.660	0.810	0.910	1.050	1.190	0	0	0.00%
S332BAuto	TN	mg N/L	80	15AUG2011 - 30APR2012	25	0.944	0.154	0.688	0.838	0.935	1.070	1.231	0	0	0.00%
S332BAuto	TP	mg P/L	25	15AUG2011 - 30APR2012	23	0.010	0.002	0.007	0.008	0.009	0.011	0.014	0	0	0.00%

Table D-3. Continued.

Station	Test Name	Units	Test Number	Period of Record	# of Samples	Mean	STD	Min	Q25	Median	Q75	Max	# Below Detection Limit	# of Excursions	% Excursions
S332C	DIS. CA	mg/L	30	15AUG2011 - 30APR2012	21	73.919	3.380	68.900	71.500	73.400	76.400	79.600	0	0	0.00%
S332C	DIS. K	mg/L	29	15AUG2011 - 30APR2012	21	2.648	0.191	2.400	2.600	2.600	2.700	3.200	0	0	0.00%
S332C	DIS. MG	mg/L	31	15AUG2011 - 30APR2012	21	8.162	0.365	6.800	8.100	8.200	8.300	8.600	0	0	0.00%
S332C	DIS. NA	mg/L	28	15AUG2011 - 30APR2012	21	31.067	1.218	27.700	30.400	30.900	32.000	33.000	0	0	0.00%
S332C	DO	mg/L	8	02MAY2011 - 30APR2012	51	3.291	1.492	0.670	1.920	3.380	4.410	6.650	0	0	0.00%
S332C	FLDCOND.	UMHOS/CM	9	02MAY2011 - 30APR2012	53	594.698	60.173	536.000	560.000	573.000	596.000	806.000	0	0	0.00%
S332C	HARDNESS	mg/L CACO3	35	15AUG2011 - 30APR2012	21	218.176	8.154	206.500	212.400	217.500	222.000	233.900	0	0	0.00%
S332C	NOX	mg N/L	18;180	15AUG2011 - 30APR2012	14	0.026	0.016	0.005	0.014	0.025	0.034	0.064	0	0	0.00%
S332C	OPO4	mg P/L	23	15AUG2011 - 30APR2012	21	0.002	0.000	<0.002	<0.002	<0.002	<0.002	<0.002	21	0	0.00%
S332C	PH	UNITS	10	02MAY2011 - 30APR2012	53	7.328	0.220	6.500	7.200	7.300	7.400	7.800	0	0	0.00%
S332C	TEMP	CENT	7	02MAY2011 - 30APR2012	53	25.794	2.295	20.800	24.200	25.700	28.000	30.400	0	0	0.00%
S332C	TKN	mg N/L	21	15AUG2011 - 30APR2012	21	0.826	0.107	0.660	0.740	0.840	0.930	0.960	0	0	0.00%
S332C	TN	mg N/L	80	15AUG2011 - 30APR2012	21	0.844	0.108	0.670	0.780	0.840	0.940	0.987	0	0	0.00%
S332C	TOT. CL	mg/L	32	15AUG2011 - 30APR2012	21	46.138	10.636	<0.1	47.700	48.400	48.800	51.500	1	0	0.00%
S332C	TP	mg P/L	25	02MAY2011 - 30APR2012	51	0.008	0.004	0.004	0.006	0.007	0.008	0.021	0	0	0.00%
S332C	TSS	mg/L	16	15AUG2011 - 30APR2012	21	3.000	0.000	<3	<3	<3	<3	<3	21	0	0.00%
S332CAuto	NOX	mg N/L	18;180	06JUN2011 - 30APR2012	17	0.038	0.049	0.014	0.017	0.025	0.033	0.220	0	0	0.00%
S332CAuto	TKN	mg N/L	21	06JUN2011 - 30APR2012	26	0.883	0.112	0.710	0.810	0.880	0.950	1.260	0	0	0.00%
S332CAuto	TN	mg N/L	80	06JUN2011 - 30APR2012	26	0.908	0.143	0.726	0.810	0.906	0.970	1.480	0	0	0.00%
S332CAuto	TP	mg P/L	25	06JUN2011 - 30APR2012	24	0.009	0.003	0.005	0.008	0.009	0.010	0.017	0	0	0.00%
S332DX	CA_I	mg/L	188	24OCT2011 - 09FEB2012	2	3.900	0.990	3.200	3.200	3.900	4.600	4.600	0	0	0.00%
S332DX	DIS. CA	mg/L	30	02MAY2011 - 30APR2012	42	74.588	5.835	64.800	71.300	72.800	76.700	98.400	0	0	0.00%
S332DX	DIS. K	mg/L	29	02MAY2011 - 30APR2012	42	2.921	0.912	2.200	2.500	2.600	2.900	5.900	0	0	0.00%
S332DX	DIS. MG	mg/L	31	02MAY2011 - 30APR2012	42	9.152	2.555	7.100	8.000	8.200	8.500	18.300	0	0	0.00%
S332DX	DIS. NA	mg/L	28	02MAY2011 - 30APR2012	42	35.110	7.692	29.100	31.200	32.300	34.400	65.000	0	0	0.00%
S332DX	DIS. ORGAN. C	mg/L	89;181	12JUL2011 - 03APR2012	4	13.200	3.041	9.600	11.150	13.100	15.250	17.000	0	0	0.00%

Table D-3. Continued.

Station	Test Name	Units	Test Number	Period of Record	# of Samples	Mean	STD	Min	Q25	Median	Q75	Max	# Below Detection Limit	# of Excursions	% Excursions
S332DX	DO	mg/L	8	02MAY2011 - 30APR2012	52	3.894	1.825	0.850	2.205	4.010	5.110	7.680	0	0	0.00%
S332DX	FLDCOND.	UMHOS/CM	9	02MAY2011 - 30APR2012	54	597.667	64.092	544.000	557.000	574.000	603.000	834.000	0	0	0.00%
S332DX	HARDNESS	mg/L CACO3	35	02MAY2011 - 30APR2012	42	223.943	21.991	202.200	212.200	216.750	225.400	307.200	0	0	0.00%
S332DX	NOX	mg N/L	18;180	02MAY2011 - 30APR2012	33	0.078	0.078	0.005	0.022	0.041	0.108	0.330	0	0	0.00%
S332DX	OPO4	mg P/L	23	02MAY2011 - 30APR2012	41	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.002	39	0	0.00%
S332DX	PH	UNITS	10	02MAY2011 - 30APR2012	54	7.369	0.249	6.700	7.200	7.400	7.500	7.900	0	0	0.00%
S332DX	TEMP	CENT	7	02MAY2011 - 30APR2012	54	26.011	2.316	20.500	24.700	26.100	27.700	30.200	0	0	0.00%
S332DX	TKN	mg N/L	21	02MAY2011 - 30APR2012	41	0.899	0.186	0.650	0.740	0.850	1.040	1.300	0	0	0.00%
S332DX	TN	mg N/L	80	02MAY2011 - 30APR2012	41	0.962	0.252	0.666	0.776	0.888	1.115	1.620	0	0	0.00%
S332DX	TOT. CL	mg/L	32	02MAY2011 - 30APR2012	43	52.440	17.472	<0.1	48.300	50.700	56.100	98.000	1	0	0.00%
S332DX	TOT. MTHY HG	µg/L	203	21JUL2011 - 17APR2012	4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.00%
S332DX	TOT. SO4	mg/L	33	12JUL2011 - 03APR2012	4	3.500	1.352	1.800	2.500	3.600	4.500	5.000	0	0	0.00%
S332DX	TOT. ULTRA TRACE HG	µg/L	207	21JUL2011 - 17APR2012	4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.00%
S332DX	TP	mg P/L	25	02MAY2011 - 30APR2012	51	0.008	0.004	0.005	0.006	0.007	0.008	0.019	0	0	0.00%
S332DX	TSS	mg/L	16	02MAY2011 - 30APR2012	41	3.000	0.000	<3	<3	<3	<3	<3	41	0	0.00%
S332DX	TURBIDITY	NTU	12	12JUL2011 - 03APR2012	6	5.533	6.203	0.800	1.400	2.000	13.000	14.000	0	0	0.00%
S332DXAuto	NOX	mg N/L	18;180	02MAY2011 - 30APR2012	304	0.077	0.069	<0.005	0.020	0.071	0.115	0.328	22	0	0.00%
S332DXAuto	TKN	mg N/L	21	02MAY2011 - 30APR2012	370	0.927	0.196	0.610	0.760	0.890	1.060	2.140	0	0	0.00%
S332DXAuto	TN	mg N/L	80	02MAY2011 - 30APR2012	370	0.990	0.254	0.638	0.770	0.917	1.164	2.221	0	0	0.00%
S332DXAuto	TP	mg P/L	25	02MAY2011 - 30APR2012	340	0.009	0.004	0.004	0.006	0.007	0.010	0.025	0	0	0.00%
BERMB3	DIS. CA	mg/L	30	17OCT2011 - 31OCT2011	2	53.450	3.465	51.000	51.000	53.450	55.900	55.900	0	0	0.00%
BERMB3	DIS. K	mg/L	29	17OCT2011 - 31OCT2011	2	2.300	0.707	1.800	1.800	2.300	2.800	2.800	0	0	0.00%
BERMB3	DIS. MG	mg/L	31	17OCT2011 - 31OCT2011	2	3.000	0.283	2.800	2.800	3.000	3.200	3.200	0	0	0.00%
BERMB3	DIS. NA	mg/L	28	17OCT2011 - 31OCT2011	2	5.900	3.536	3.400	3.400	5.900	8.400	8.400	0	0	0.00%
BERMB3	DO	mg/L	8	17OCT2011 - 14NOV2011	3	4.003	2.173	2.160	2.160	3.450	6.400	6.400	0	0	0.00%

Table D-3. Continued.

Station	Test Name	Units	Test Number	Period of Record	# of Samples	Mean	STD	Min	Q25	Median	Q75	Max	# Below Detection Limit	# of Excursions	% Excursions
BERMB3	FLDCOND.	UMHOS/CM	9	17OCT2011 - 12DEC2011	4	355.750	62.007	278.000	311.500	359.000	400.000	427.000	0	0	0.00%
BERMB3	HARDNESS	mg/L CACO3	35	17OCT2011 - 31OCT2011	2	145.700	10.041	138.600	138.600	145.700	152.800	152.800	0	0	0.00%
BERMB3	NOX	mg N/L	18;180	31OCT2011 - 31OCT2011	1	0.005		<0.005	<0.005	<0.005	<0.005	<0.005	1	0	0.00%
BERMB3	OPO4	mg P/L	23	17OCT2011 - 31OCT2011	2	0.017	0.011	0.009	0.009	0.017	0.025	0.025	0	0	0.00%
BERMB3	PH	UNITS	10	17OCT2011 - 12DEC2011	4	7.175	0.206	7.000	7.000	7.150	7.350	7.400	0	0	0.00%
BERMB3	TEMP	CENT	7	17OCT2011 - 12DEC2011	4	23.550	1.752	21.500	22.100	23.750	25.000	25.200	0	0	0.00%
BERMB3	TKN	mg N/L	21	17OCT2011 - 31OCT2011	2	0.970	0.071	0.920	0.920	0.970	1.020	1.020	0	0	0.00%
BERMB3	TN	mg N/L	80	17OCT2011 - 31OCT2011	2	0.970	0.071	0.920	0.920	0.970	1.020	1.020	0	0	0.00%
BERMB3	TOT. CL	mg/L	32	17OCT2011 - 31OCT2011	2	8.750	6.293	4.300	4.300	8.750	13.200	13.200	0	0	0.00%
BERMB3	TOT. SO4	mg/L	33	17OCT2011 - 31OCT2011	2	0.200	0.000	0.200	0.200	0.200	0.200	0.200	0	0	0.00%
BERMB3	TP	mg P/L	25	17OCT2011 - 12DEC2011	4	0.064	0.020	0.039	0.048	0.065	0.079	0.086	0	0	0.00%
BERMB3	TSS	mg/L	16	17OCT2011 - 31OCT2011	2	3.000	0.000	<3	<3	<3	<3	<3	2	0	0.00%
BERMB3	TURBIDITY	NTU	12	17OCT2011 - 31OCT2011	2	1.800	0.283	1.600	1.600	1.800	2.000	2.000	0	0	0.00%
S331-173	TURBIDITY	NTU	12	12July2011 –03APR2012	4	1.75	0.858	1.1	1.22	1.45	1.95	3.000	0	0	0.00%
S331-173	TOT. SO4	mg/L	33	12July2011 –03APR2012	4	8.275	8.154	1.4	3.08	5.90	10.675	19.90	0	0	0.00%
S331-173	DIS. ORGAN. C	mg/L	89;181	12July2011 –03APR2012	4	15.55	1.603	14	14.72	15.2	15.85	17.8	0	0	0.00%

Table D-4. WY2012 summary results of C-111 EO #9 total dissolved solids (TDS) in groundwater.

Emergency Order #9 Permit Structure	Water Quality Sampling Site	Total Flow Volume (acre-ft)	Total Dissolved Solids (mg/L) in Groundwater by quarter				Total Load (metric tons)
			1st	2nd	3rd	4th	
S332B	S332BED	64,821	342	338	260	324	26,126
	S332BES		340	334	302	336	
	S332BWD		312	360	324	302	
	S332BWS		322	306	336	390	
S332C	S332CED	82,357	190	176	184	203	28,559
	S332CES		320	316	286	319	
	S332CWD		310	328	322	322	
	S332CWS		320	300	284	318	
S332D	S332DED	65,550	310	272	296	302	23,059
	S332DES		252	302	286	306	
	S332DWD		296	272	300	300	
	S332DWS		284	228	288	269	

Notes:

1) Water quality sample site is located on upstream side of permitted structure, unless otherwise noted with different sampling location

2) n/a indicates that flow and/or stage data are not available, or that structure is not appropriately instrumented to capture information

3) NPF indicates either structure was closed or that no positive flow was recorded on sampling days, thus a flow-weighted mean could not be calculated

4) M-Data were missing

Table D-5. WY2012 inflow summary results of C-111 EO #9 dissolved organic carbon (DOC).

Structure	Water Quality Station	Total Flow Volume (acre-feet)	Dissolved Organic Carbon (mg/L)				
			1st	2nd	3rd	4th	Annual Average
S331-S173	S331-173	89,245	15.2	14.0	15.2	17.8	15.6
S332D	S332DX	65,550	12.7	9.6	13.5	17.0	13.2

Notes:
[1] N/D - No data available

Attachment E: Time-Series and Box Plots of Total Phosphorus and Total Nitrogen at Monitoring Sites for Water Year 2012

Shi Kui Xue and Steven Hill

The graphs (**Figures E-1** through **E-38**) in this attachment depict total phosphorus (TP) and total nitrogen (TN) concentration data collected during WY2012 for IOP for Protection of the CSSS water quality monitoring sites. The graph sequencing follows the station order shown in Attachment B, **Table B-1**. The C-111 EO #9 structure locations are depicted in **Figure 1**. Additionally, the graphs are identified by monitoring site name. In most cases, the monitoring site name corresponds to the structure. If the monitoring site is a surrogate location for a structure, then the structure name(s) is/are shown in parentheses below the monitoring site name.

Most graphs depict TP data collected by grab sampling. The graphs for sites with auto-sampler data are annotated (e.g., S-332B auto-sampler). The TP data collected by each method are shown as separate data in the graphs.

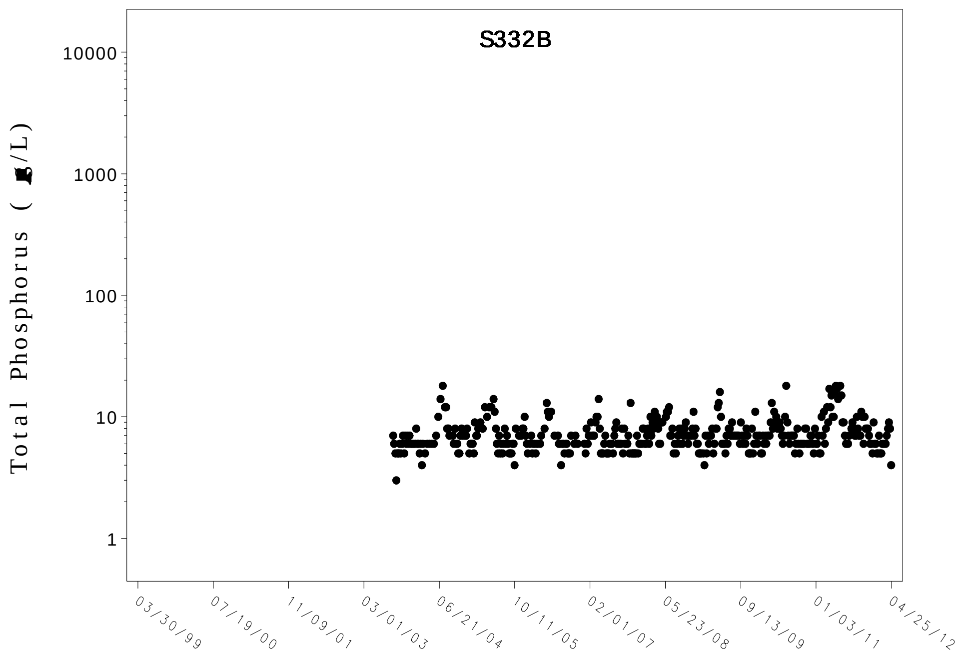

Figure E-1. TP concentration at S-332B.

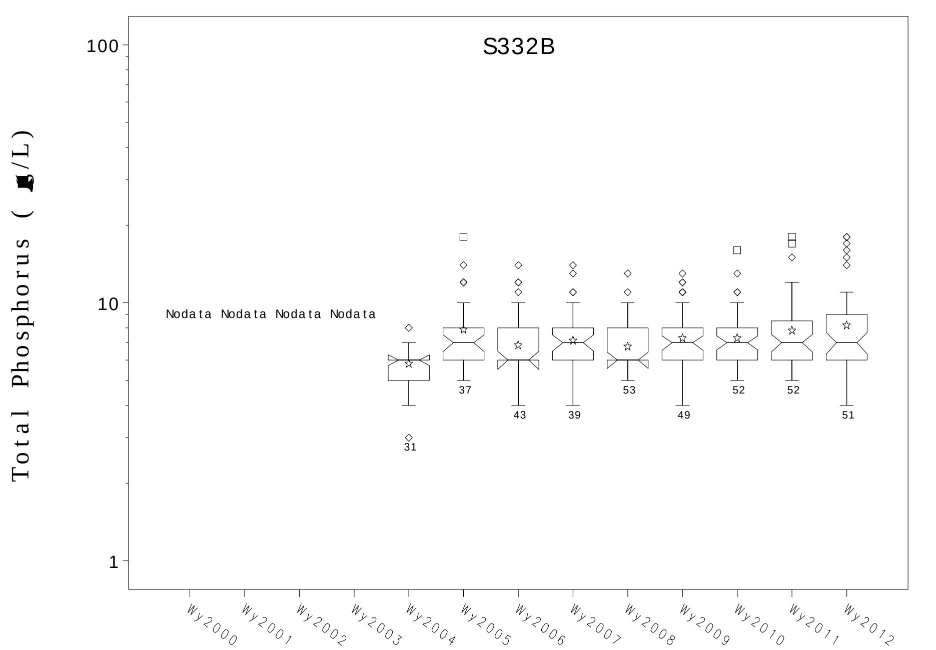

Figure E-2. TP notched-box-and-whisker plot at S-332B.

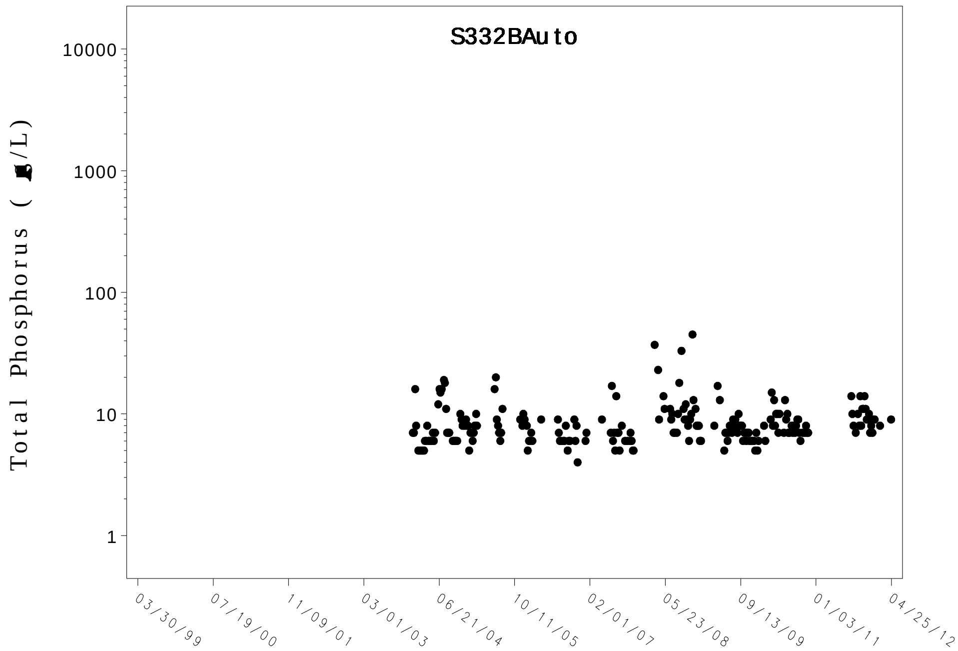

Figure E-3. TP concentration at S-332B auto-sampler.

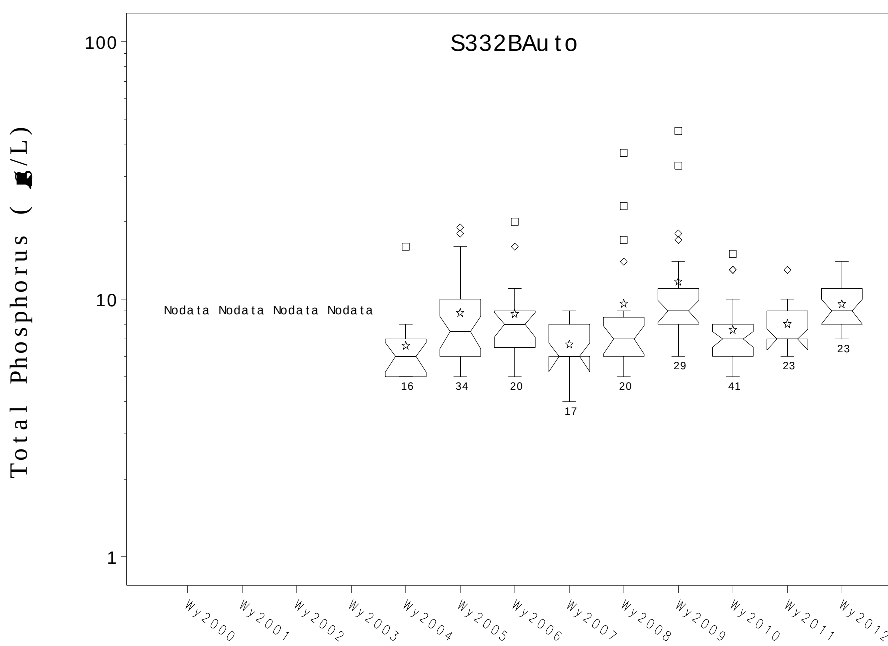

Figure E-4. TP notched-box-and-whisker plot at S-332B auto-sampler.

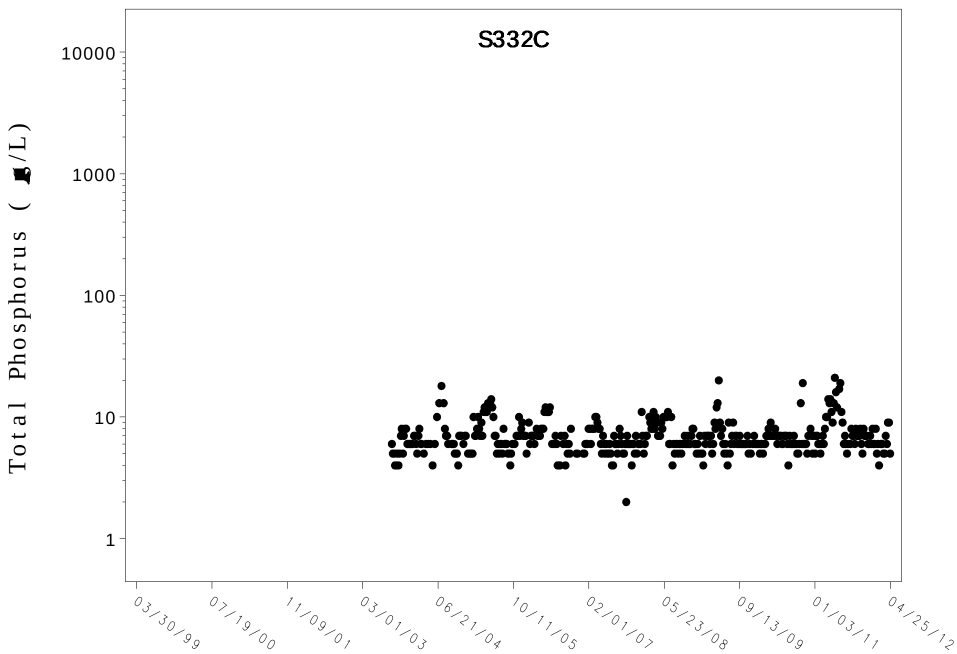

Figure E-5. TP concentration at S-332C.

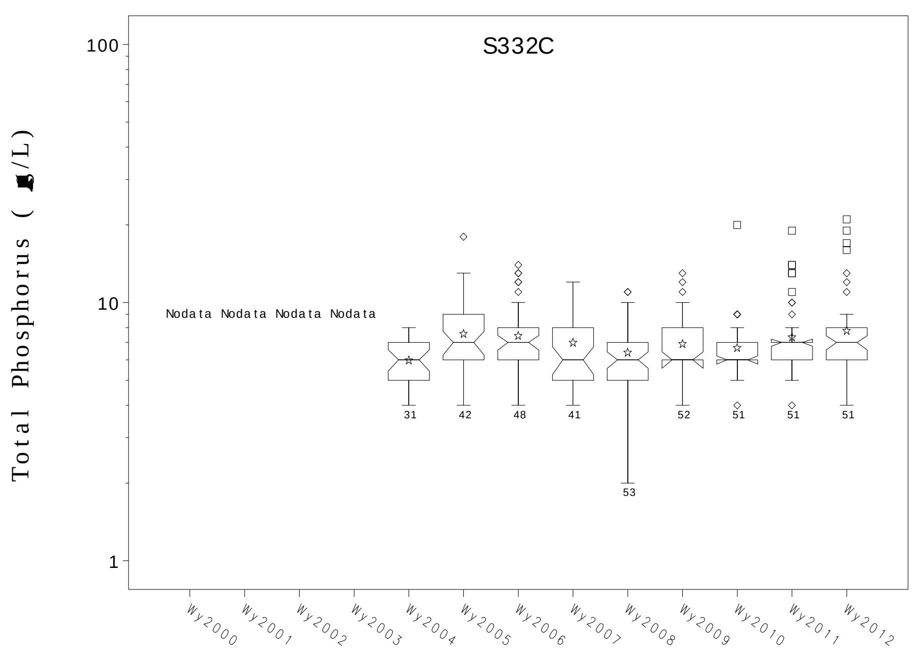

Figure E-6. TP notched-box-and-whisker plot at S-332C.

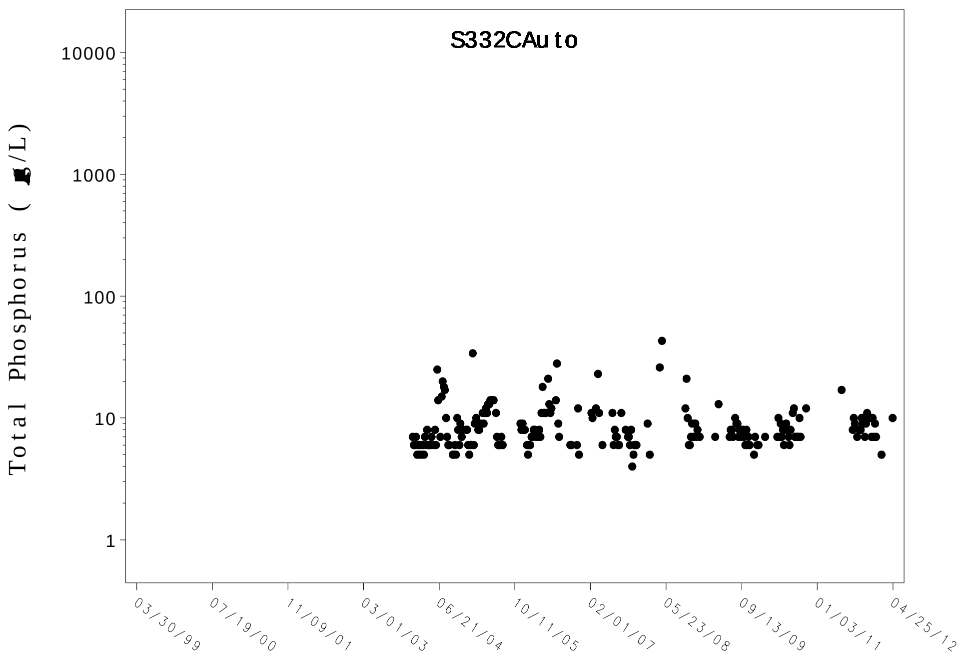

Figure E-7. TP concentration at S-332C auto-sampler.

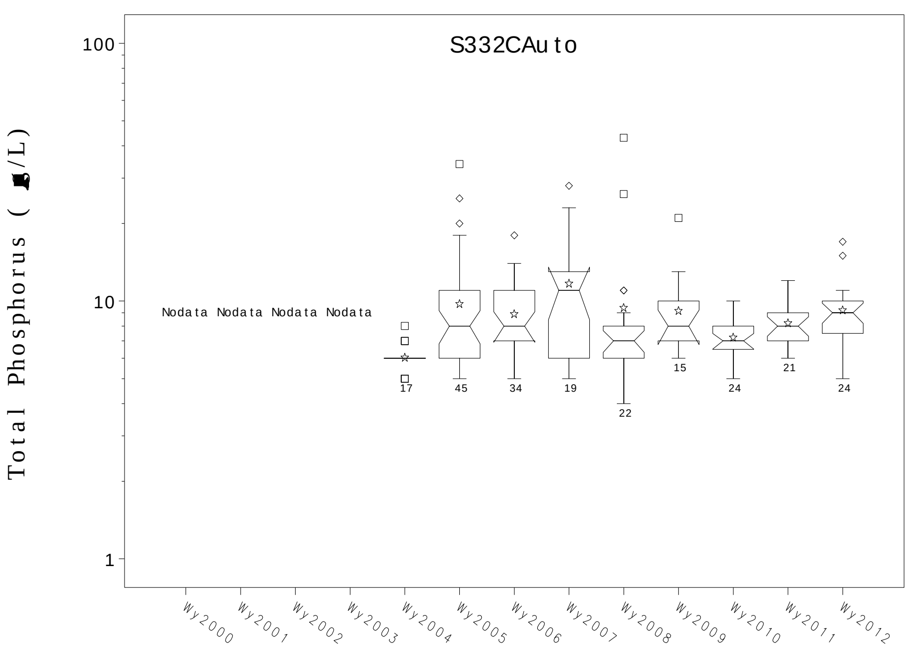

Figure E-8. TP notched-box-and-whisker plot at S-332C auto-sampler.

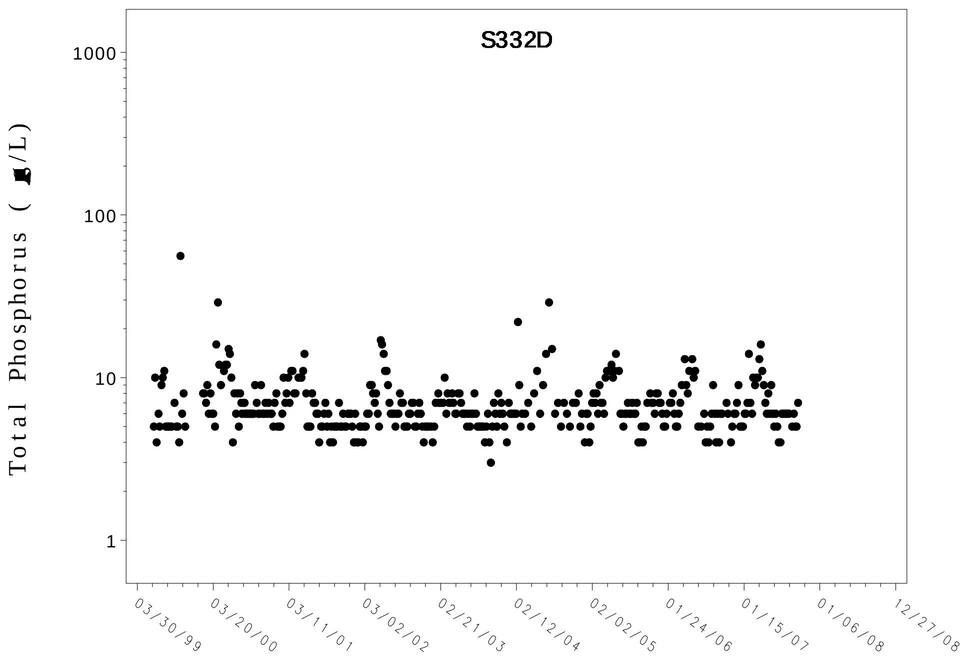

Figure E-9. TP concentration at S-332D.

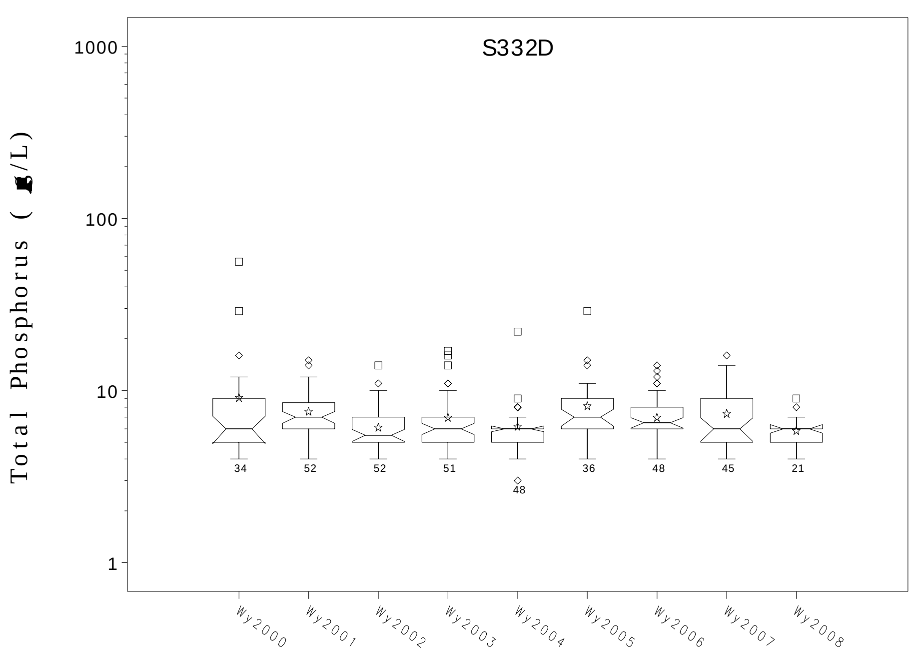

Figure E-10. TP notched-box-and-whisker plot at S-332D.

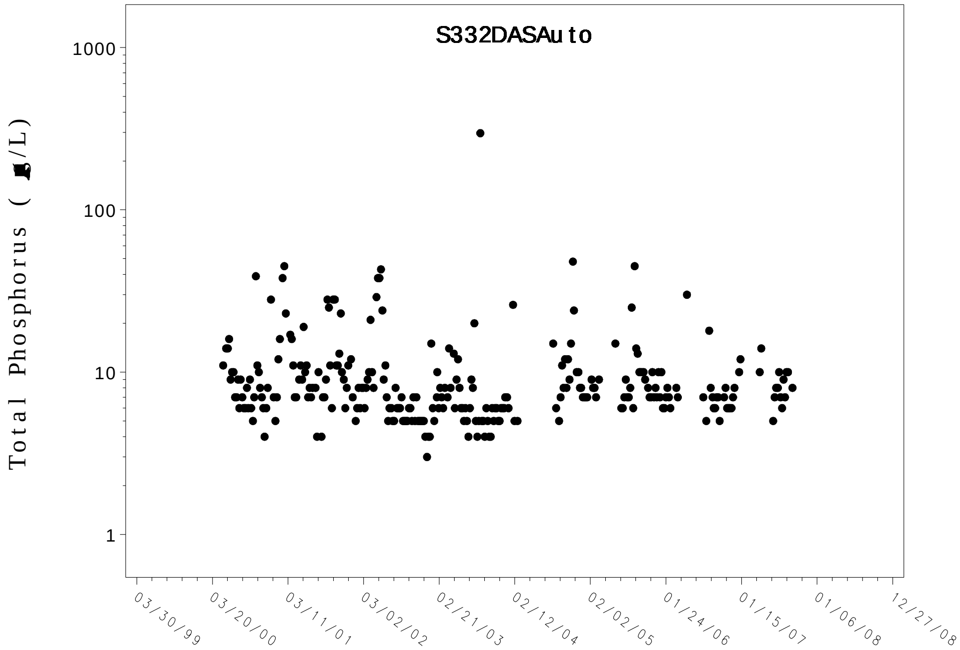

Figure E-11. TP concentration at S-332DAS auto-sampler.

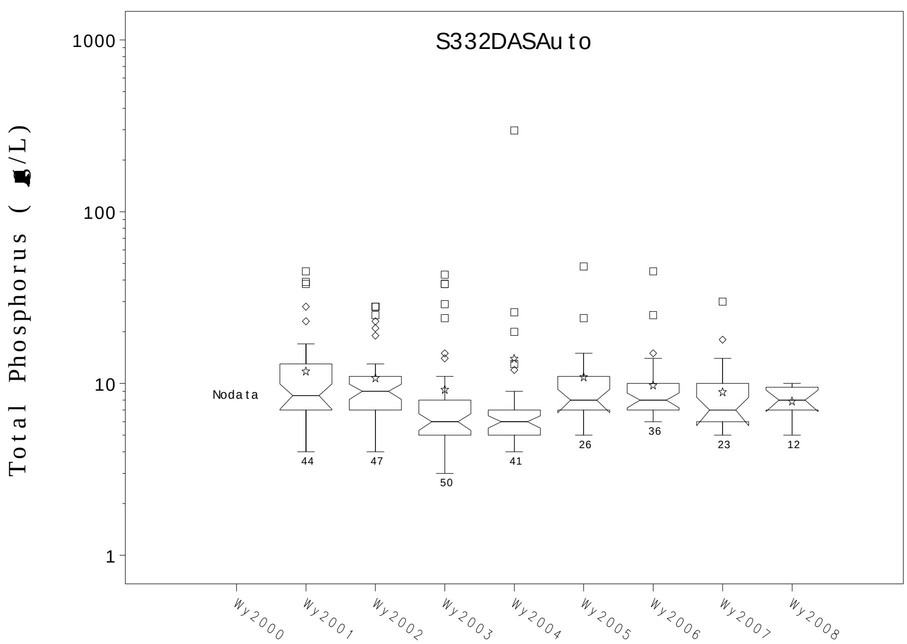

Figure E-12. TP notched-box-and-whisker plot at S-332DAS auto-sampler.

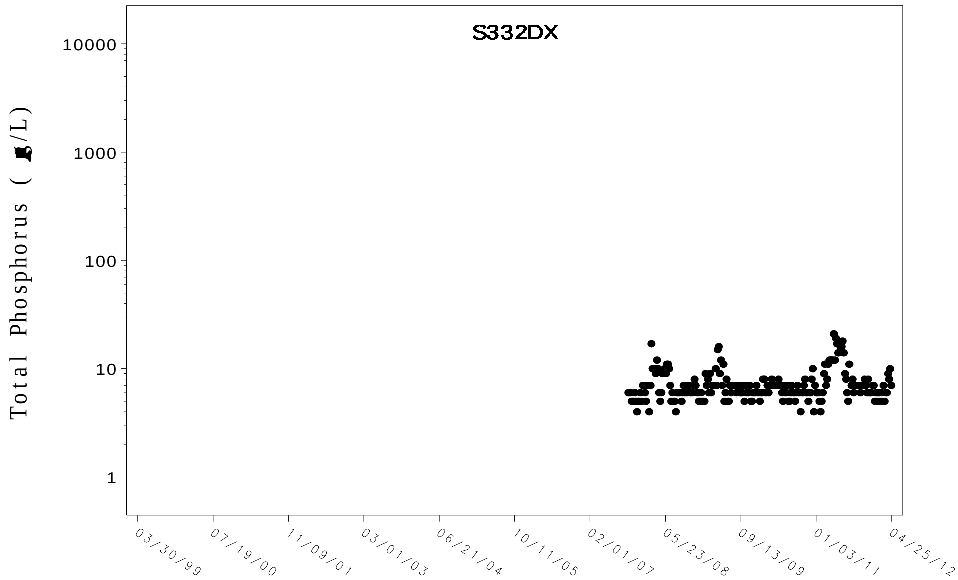

Figure E-13. TP concentration at S-332DX.

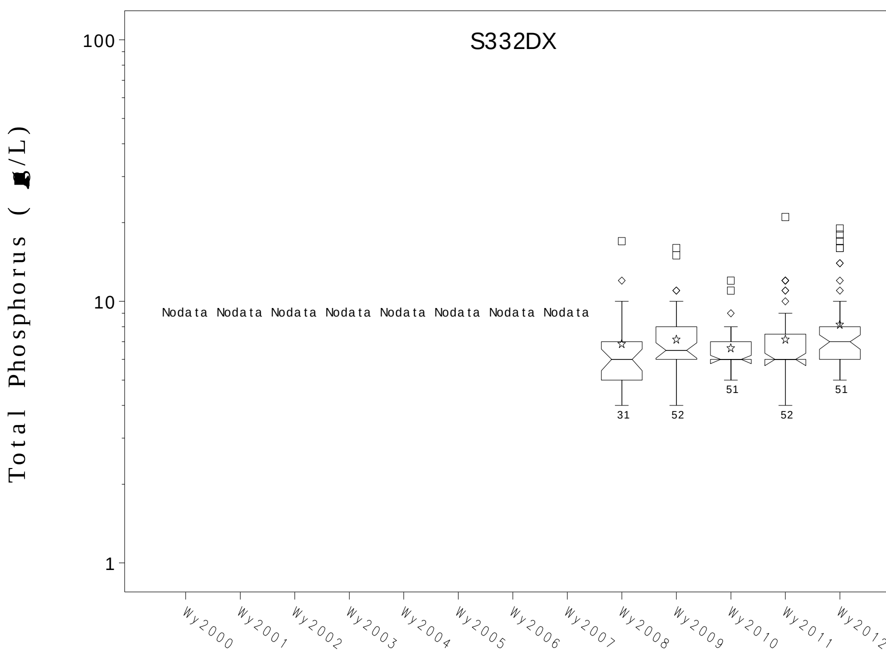

Figure E-14. TP notched-box-and-whisker plot at S-332DX.

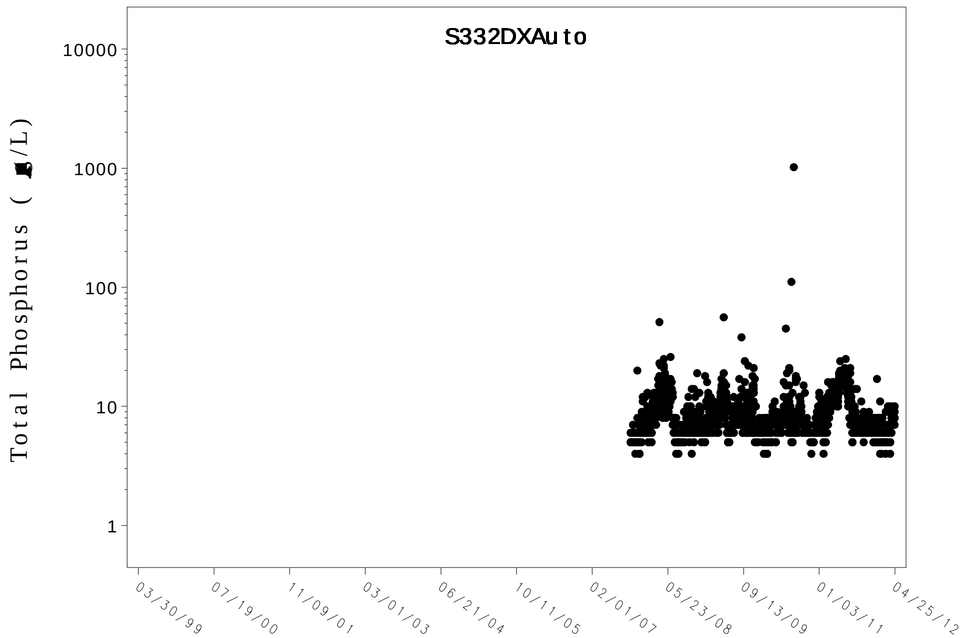

Figure E-15. TP concentration at S-332DX auto-sampler**.**

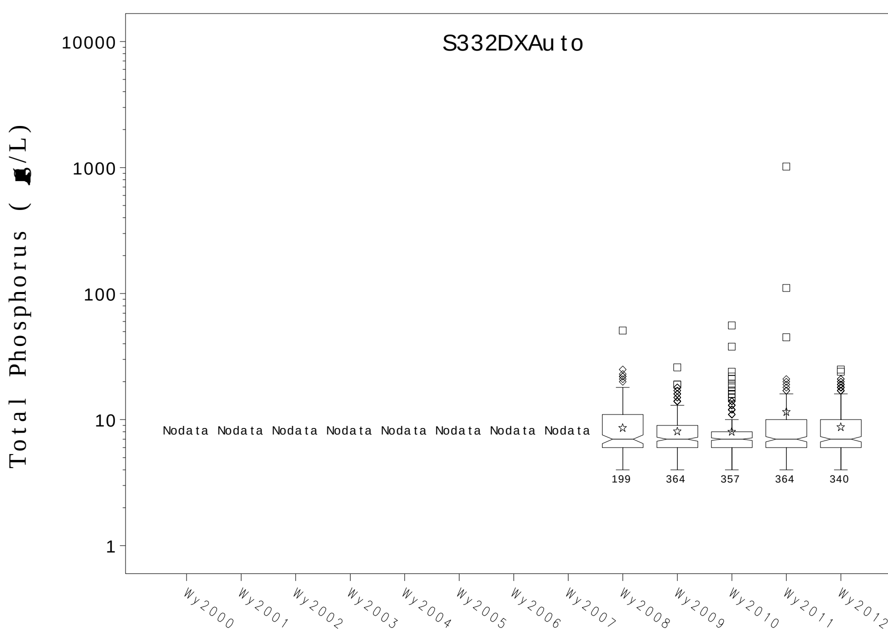

Figure E-16. TP notched-box-and-whisker plot at S-332DX auto-sampler**.**

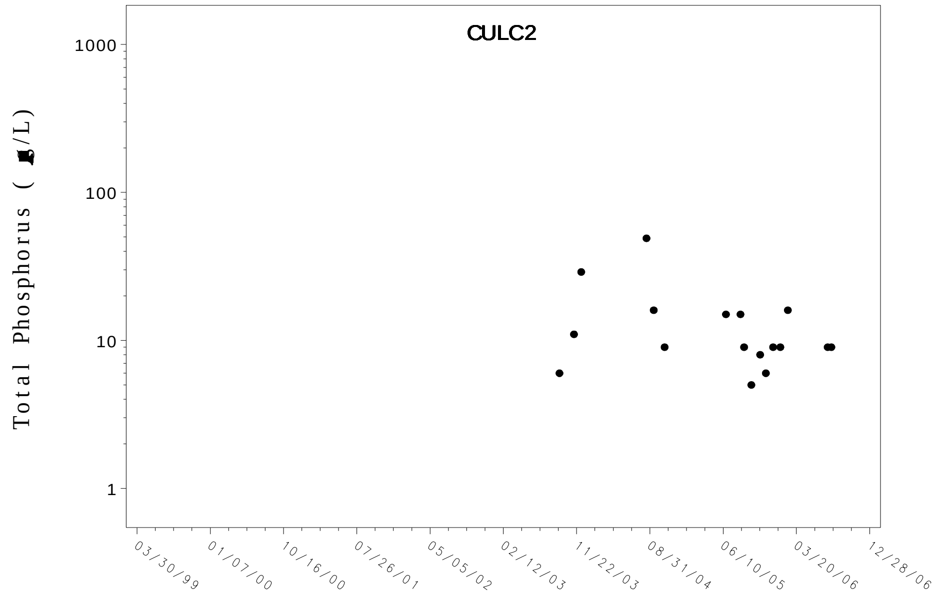

Figure E-17. TP concentration at CULC2.

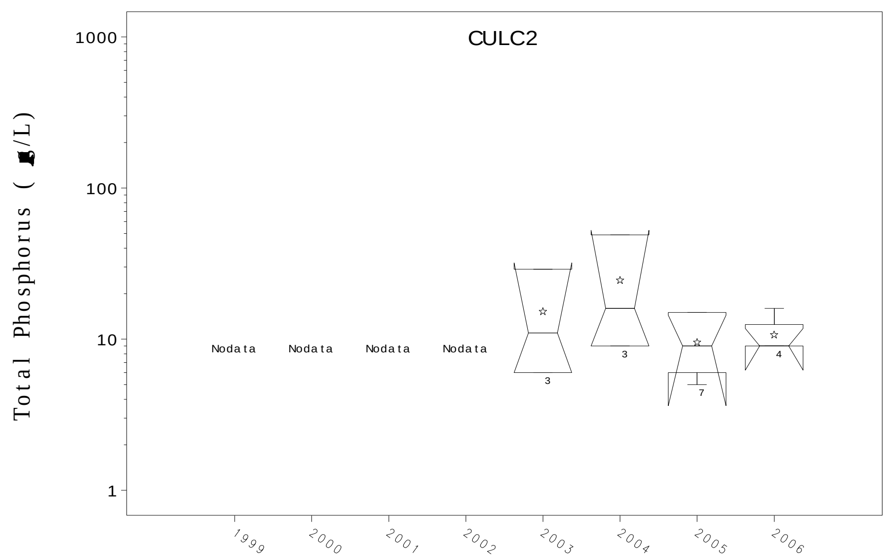

Figure E-18. TP notched box-and-whisker plot at CULC2**.**

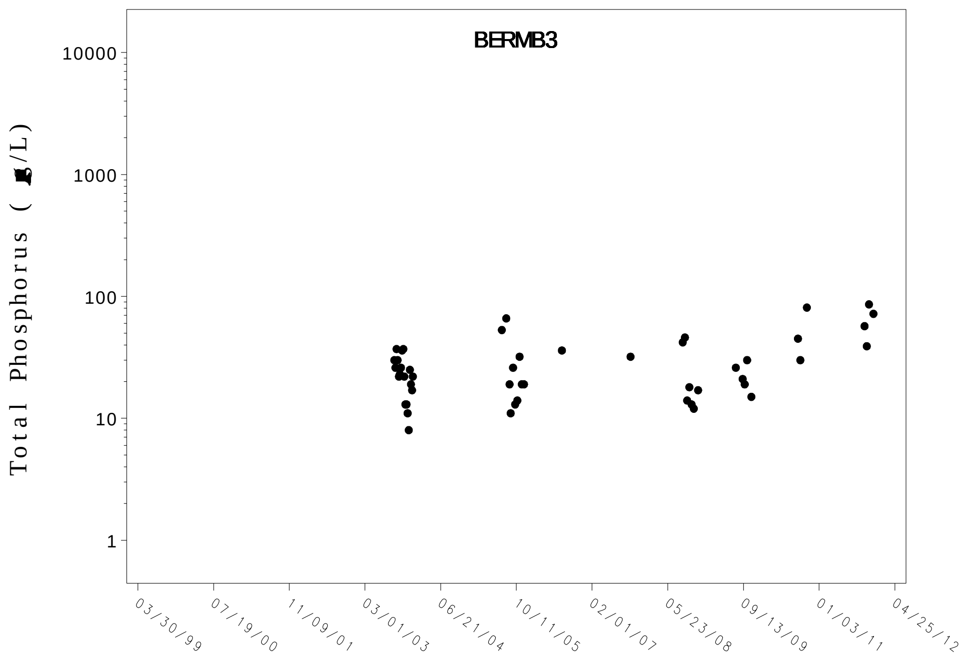

Figure E-19. TP concentration at BERMB3.

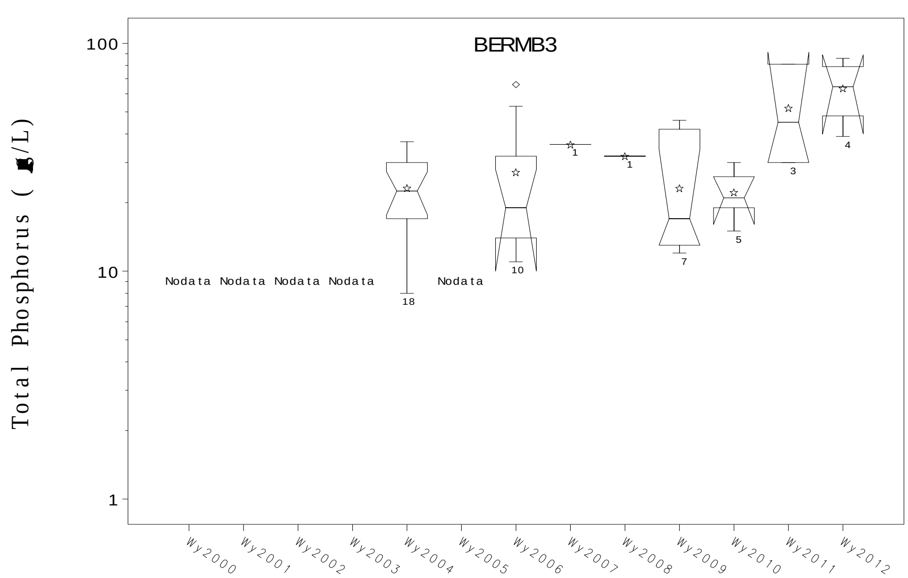

Figure E-20. TP notched-box-and-whisker plot at BERMB3.

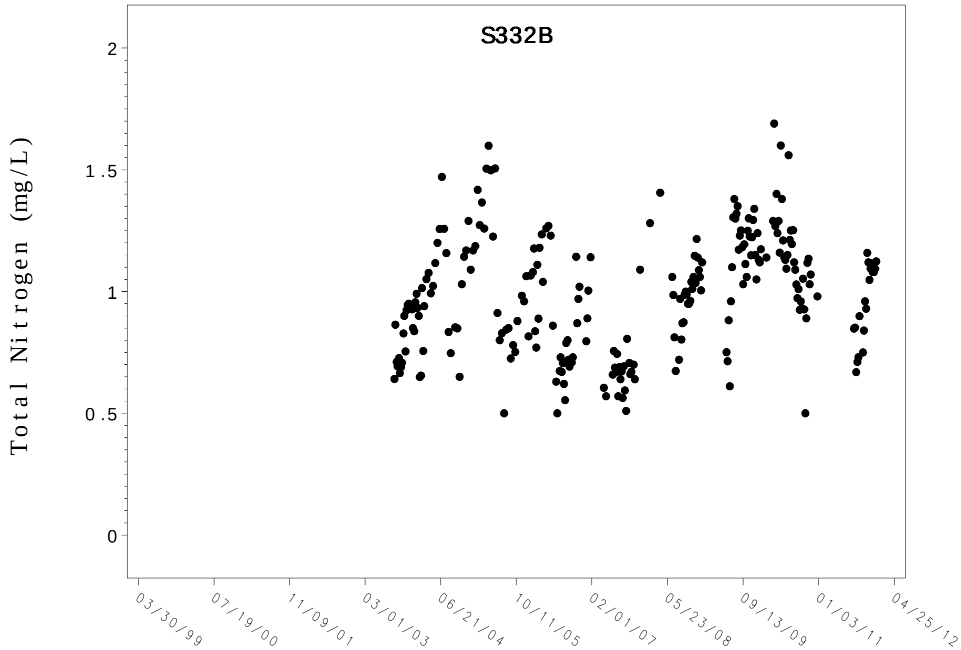

Figure E-21. TN concentration at S332B.

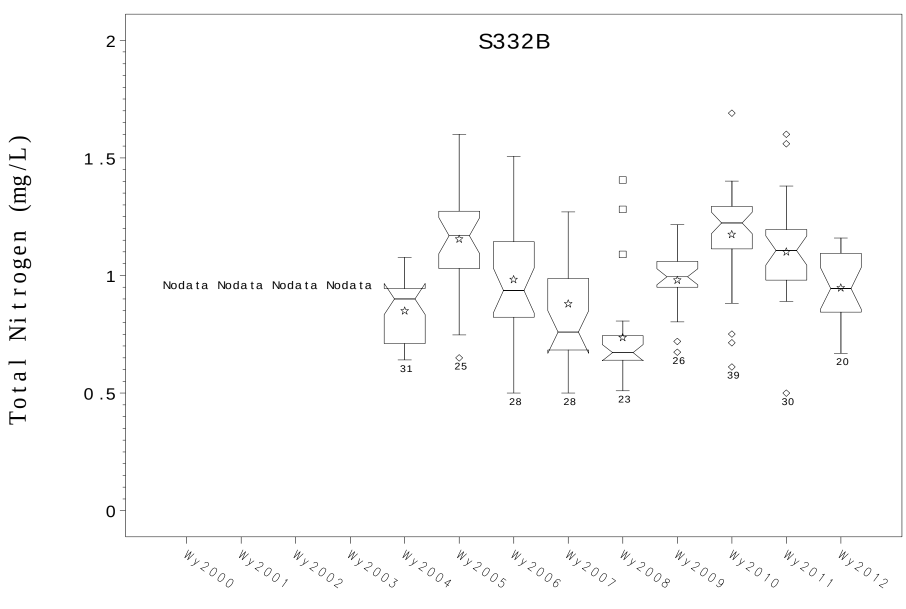

Figure E-22. TN notched-box-and-whisker plot at S332B.

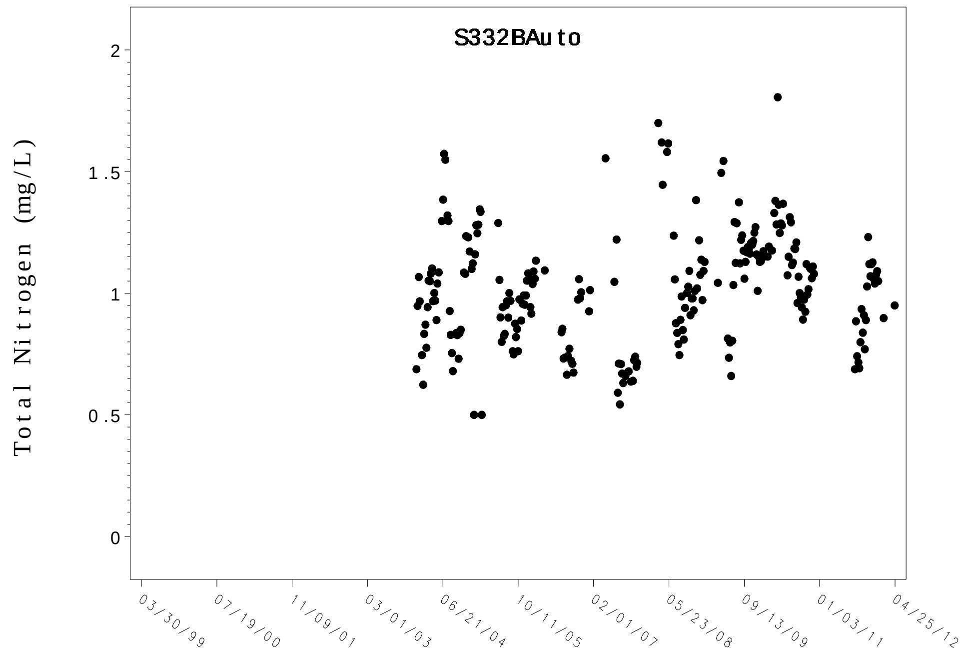

Figure E-23. TN concentration at S332B auto-sampler.

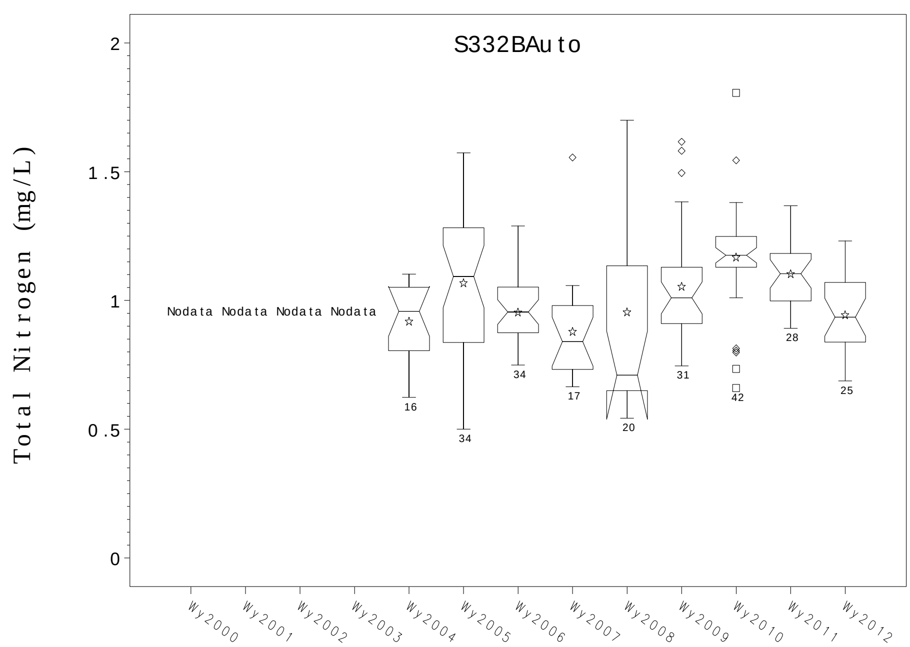

Figure E-24. TN notched-box-and-whisker plot at S332B auto-sampler.

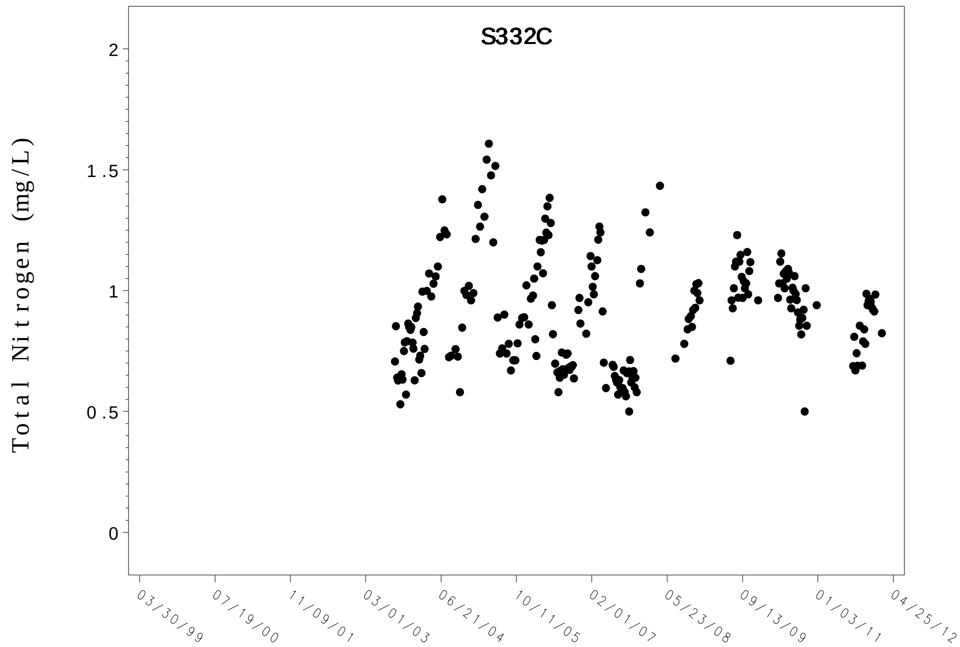

Figure E-25. TN concentration at S332C.

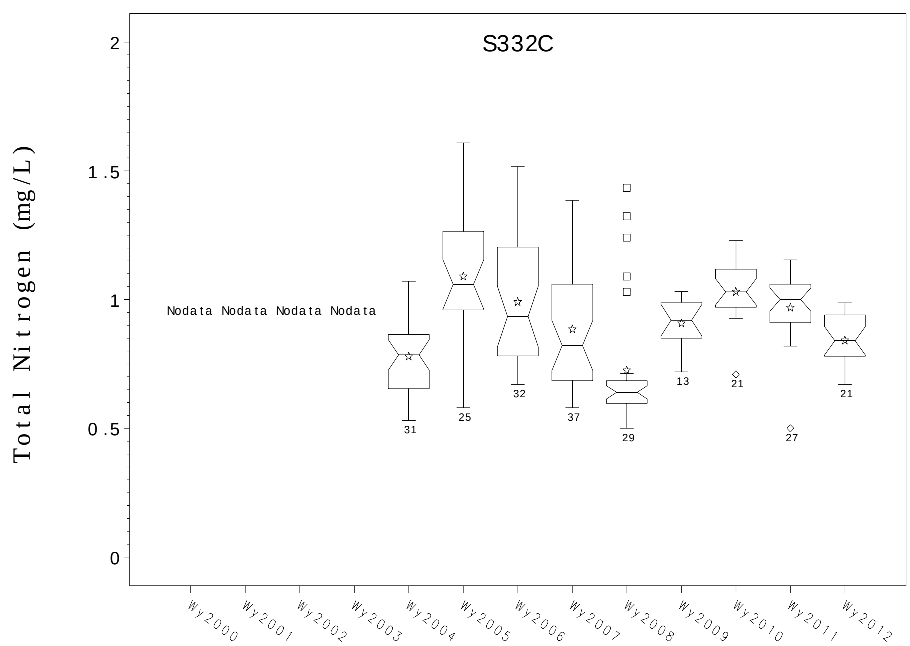

Figure E-26. TN notched-box-and-whisker plot at S332C.

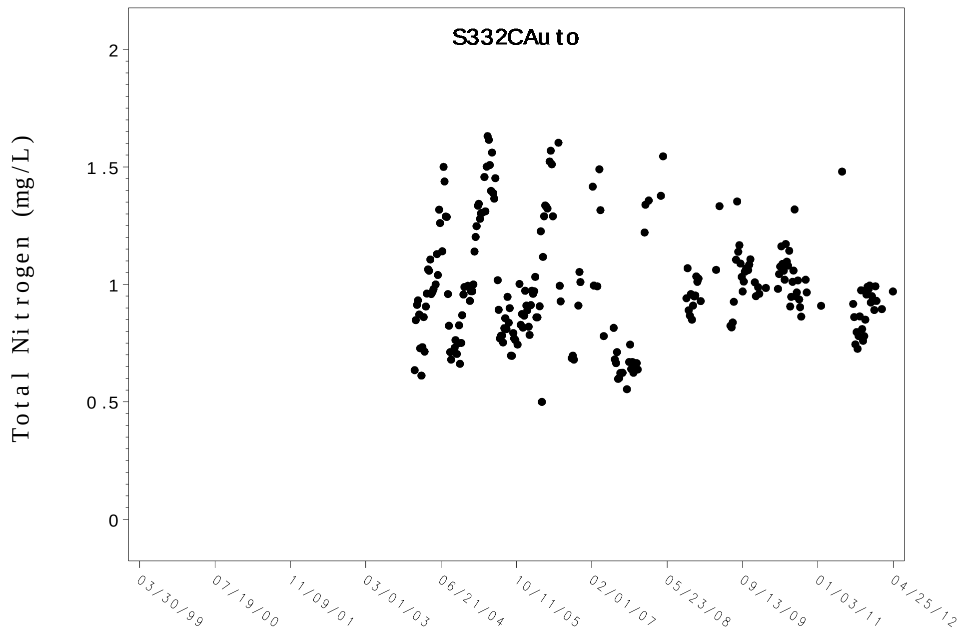

Figure E-27. TN concentration at S332C auto-sampler.

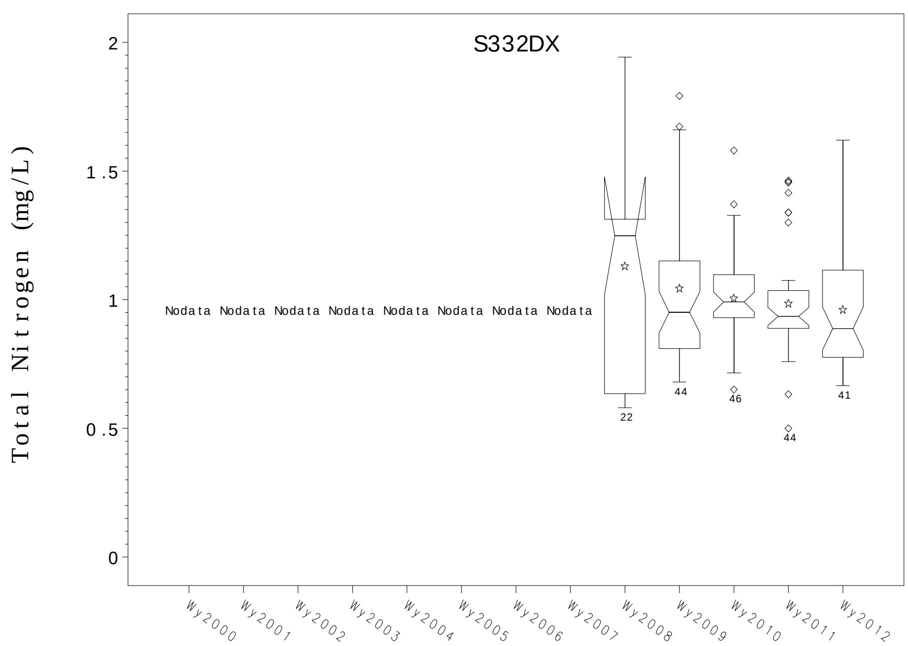

Figure E-28. TN notched-box-and-whisker plot at S332C auto-sampler.

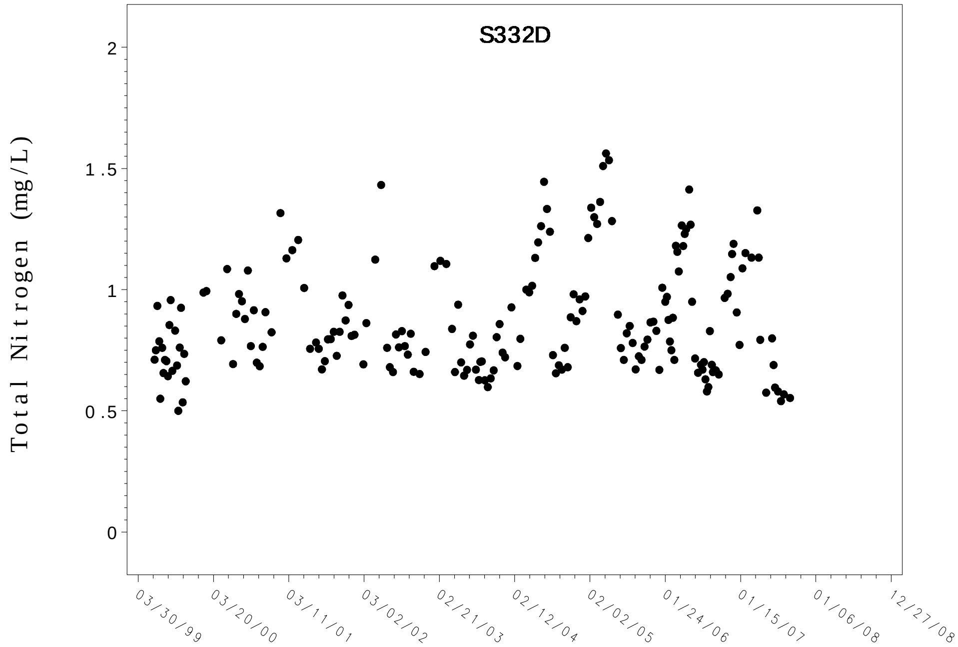

Figure E-29. TN concentration at S332D.

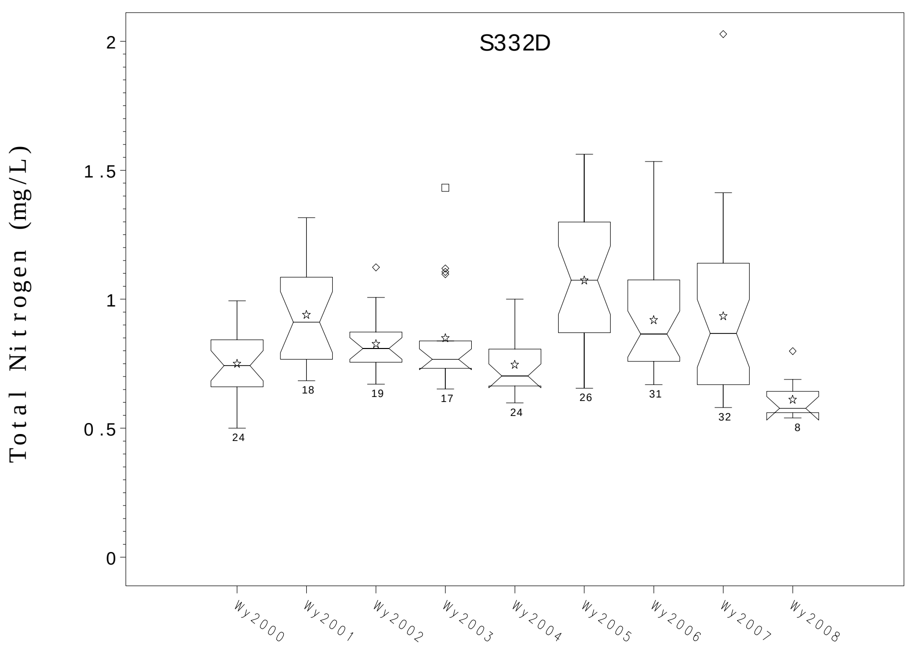

Figure E-30. TN notched box-and-whisker plot at S332D.

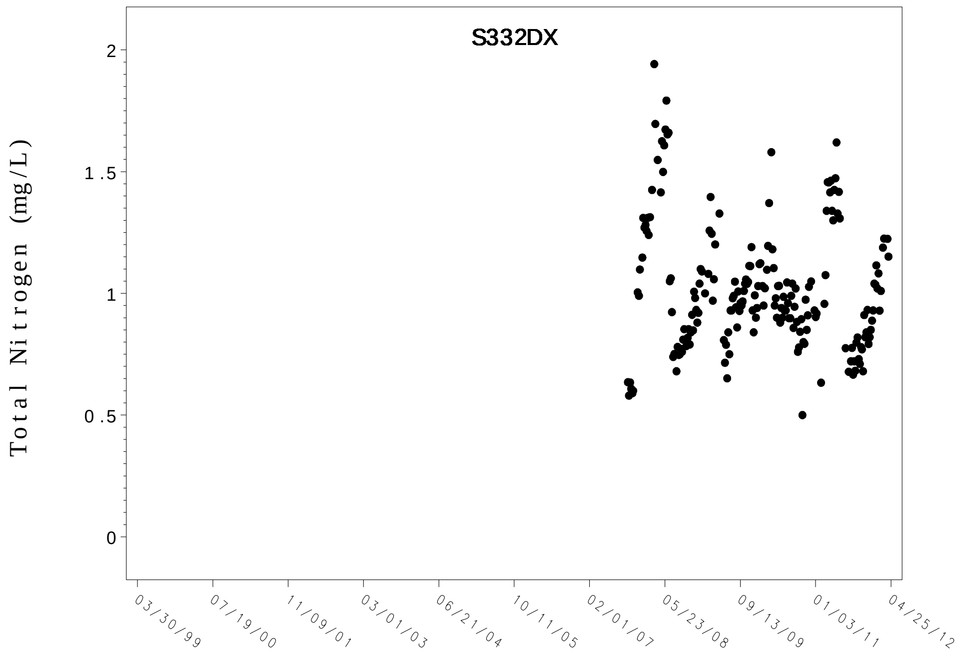

Figure E-31. TN concentration at S332DX.

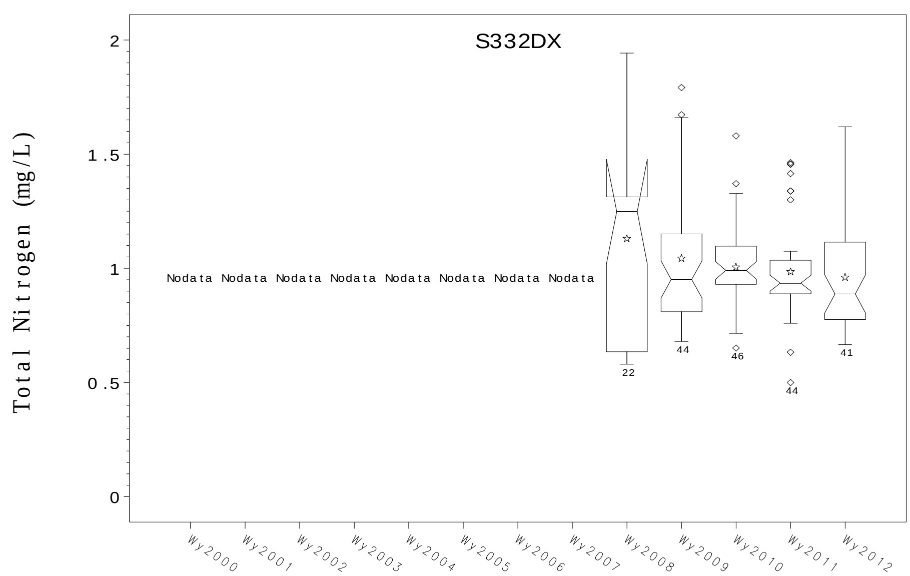

Figure E-32. TN notched-box-and-whisker plot at S332DX.

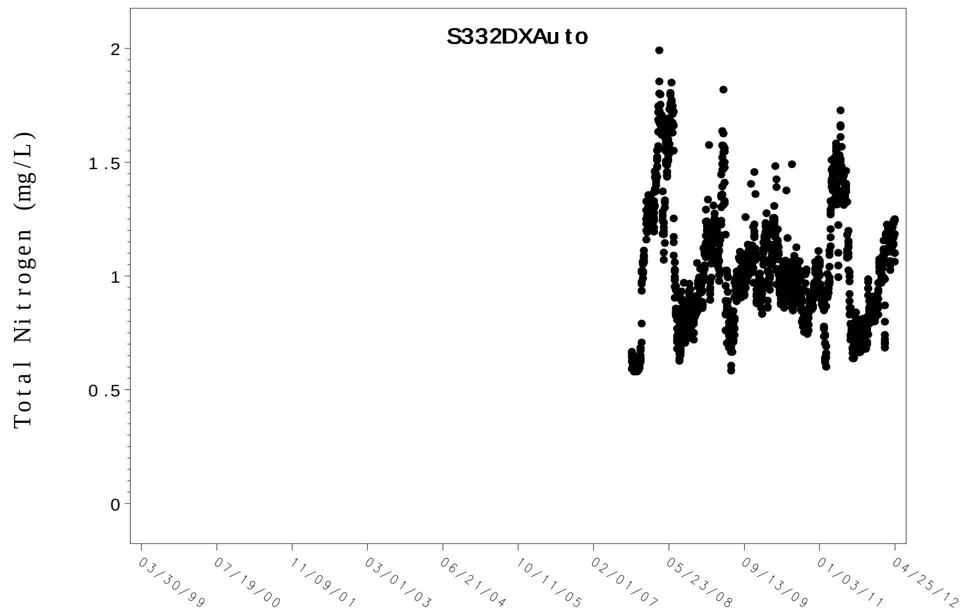

Figure E-33. TN concentration at S332DX auto-sampler.

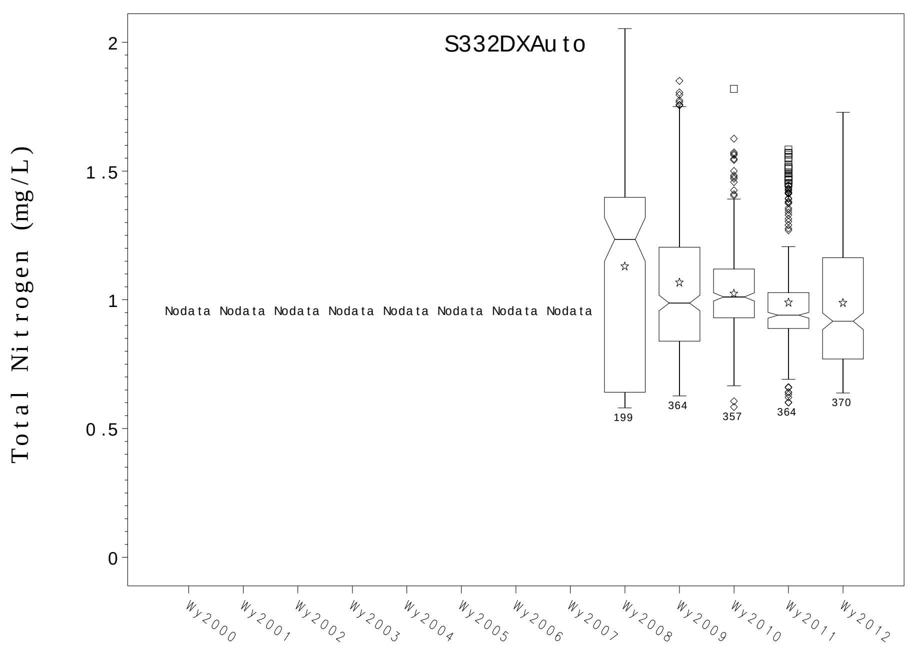

Figure E-34. TN notched-box-and-whisker plot at S332DX auto-sampler.

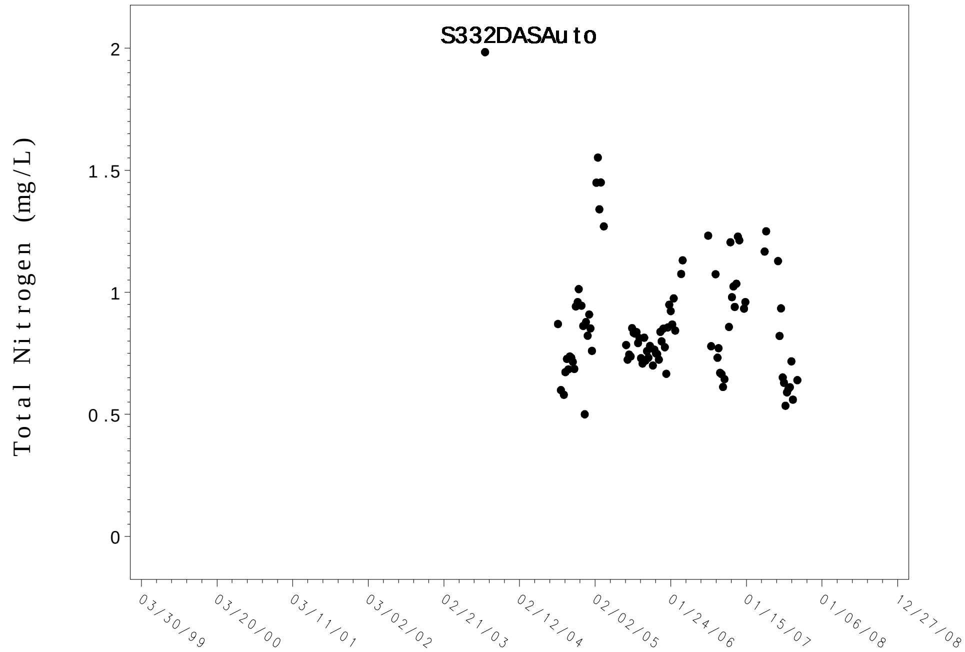

Figure E-35. TN concentration at S332DAS auto-sampler.

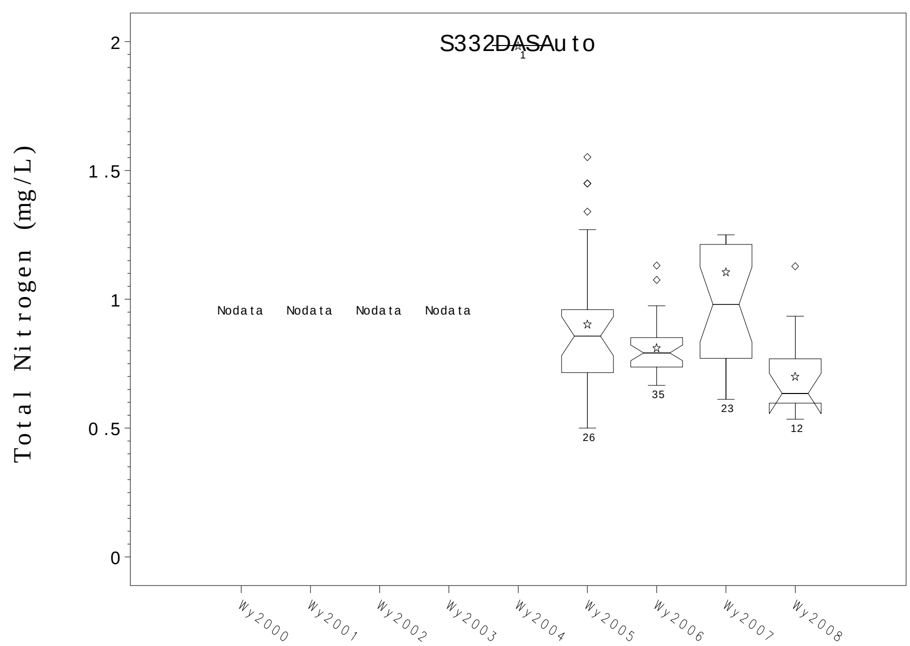

Figure E-36. TN notched box-and-whisker plot at S332DAS auto-sampler.

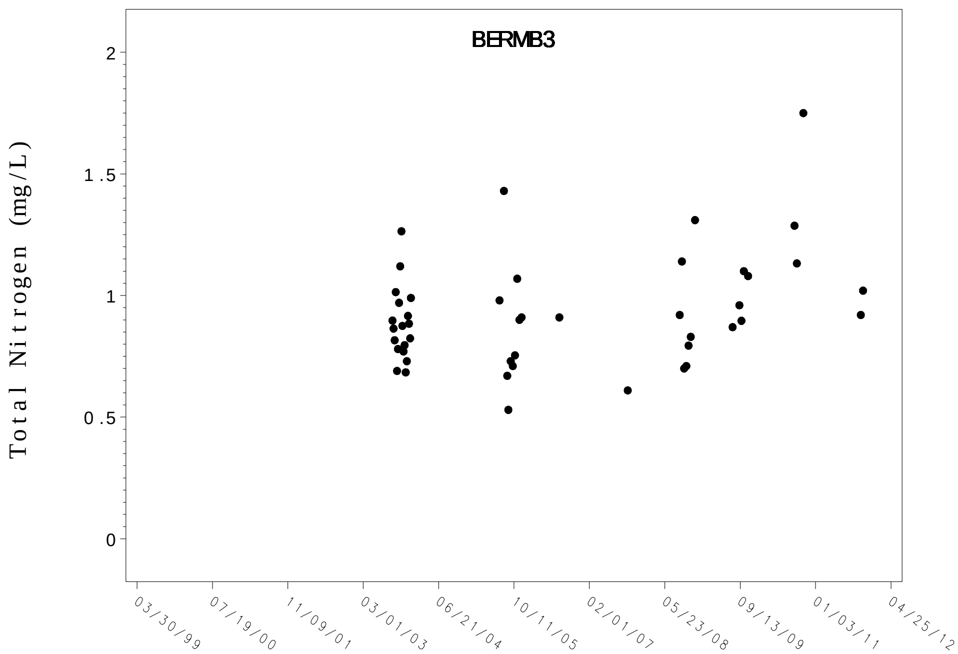

Figure E-37. TN concentration at BERMB3.

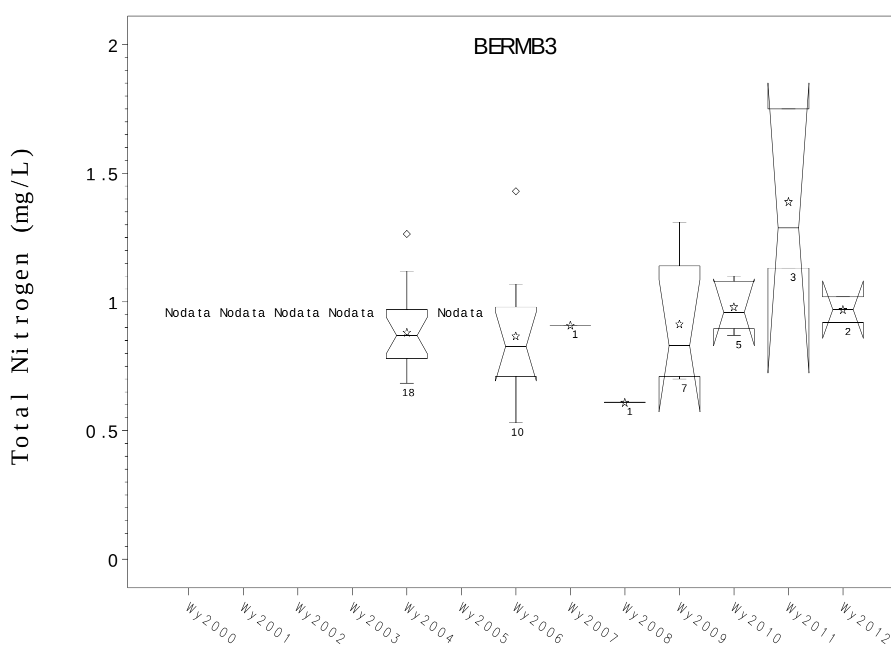

Figure E-38. TN notched-box-and-whisker plot at BERMB3.

Attachment F: Water Quality Data

This project information is required by Specific Condition 25(a) of the IOP for Protection of the CSSS Emergency Contract (Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242), and is available upon request.

Attachment G: Hydrologic Data

This project information is required by Specific Condition 25(a) of the IOP for Protection of the CSSS Emergency Contract (Ninth Amended EOGC Case Numbers: 00-0889 and 99-2242), and is available upon request.