Appendix 3A-8: Annual Water Quality Monitoring Report for Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow

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INTRODUCTION

The Central & Southern Florida Restudy (Restudy) 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 develop a conceptual plan to provide restoration of the remaining Everglades while maintaining the water supply and flood protection functions of the Central and Southern Florida Project (C&SF Project). Upon completion in 1999, the Restudy was renamed the Comprehensive Everglades Restoration Plan (CERP).

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 constructed and are currently operating under the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) (available at http://hpm.saj.usace.army.mil/csssweb/index.html as of September 2008). The IOP for Protection of the CSSS will be replaced by the Combined Structural and Operational Plan (CSOP) for the MWD ENP and C-111 Canal projects upon its completion.

The CSOP will encompass the MWD ENP and C-111 Canal projects, which are scheduled for implementation by the end of 2010. These projects consist of structural changes to the South Dade Canal Conveyance System in order to provide more natural water levels in Everglades National Park (ENP), provide water to 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 Everglades National Park (ENP or Park). **Figures 1** and **2** show the general location of the facilities monitored under this plan and the locations of major canals and roads.

The U.S. Army Corps of Engineers (USACE) submitted an application to the Florida Department of Environmental Protection (FDEP) on January 31, 2004, for an Environmental Resource Permit (ERP) to operate the S-332B, S-332C, and S-332D structures, in accordance with the IOP for Protection o 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 are in accordance with guidelines identified in Table 2.11 of the Final Environmental Impact Statement (FEIS) 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 WCA-3A. Those 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 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 Emergency Contract and the modified weir scenario identified in Specific Condition 25(g).

The FDEP found that this state of emergency is expected to continue until implementation of the CSOP. Therefore, the Emergency Final Order will remain in effect until implementation of the CSOP, unless rescinded, modified, or extended by further order of the FDEP. This Emergency Final Order was effective as of January 31, 2003.

Four individual, annual reports for calendar years 2004–2007 were submitted to the FDEP, respectively. This appendix of the *2009 South Florida Environmental Report (SFER) – Volume I* is the first annual water quality monitoring report under the Emergency Final Order and presents water quality results for WY2008 (May 1, 2007 through April 30, 2008).

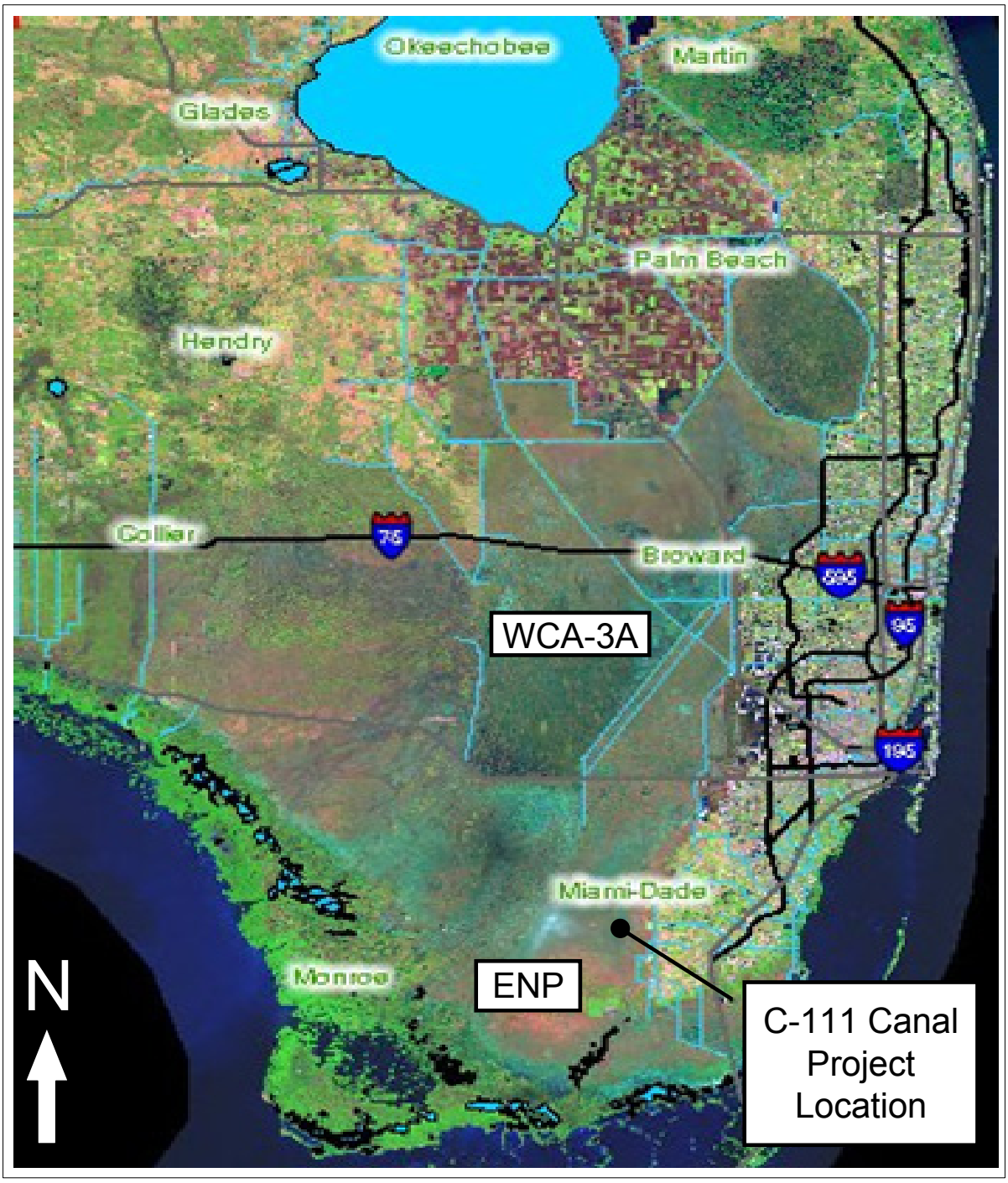


Figure 1. General location of facilities monitored under the Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow.

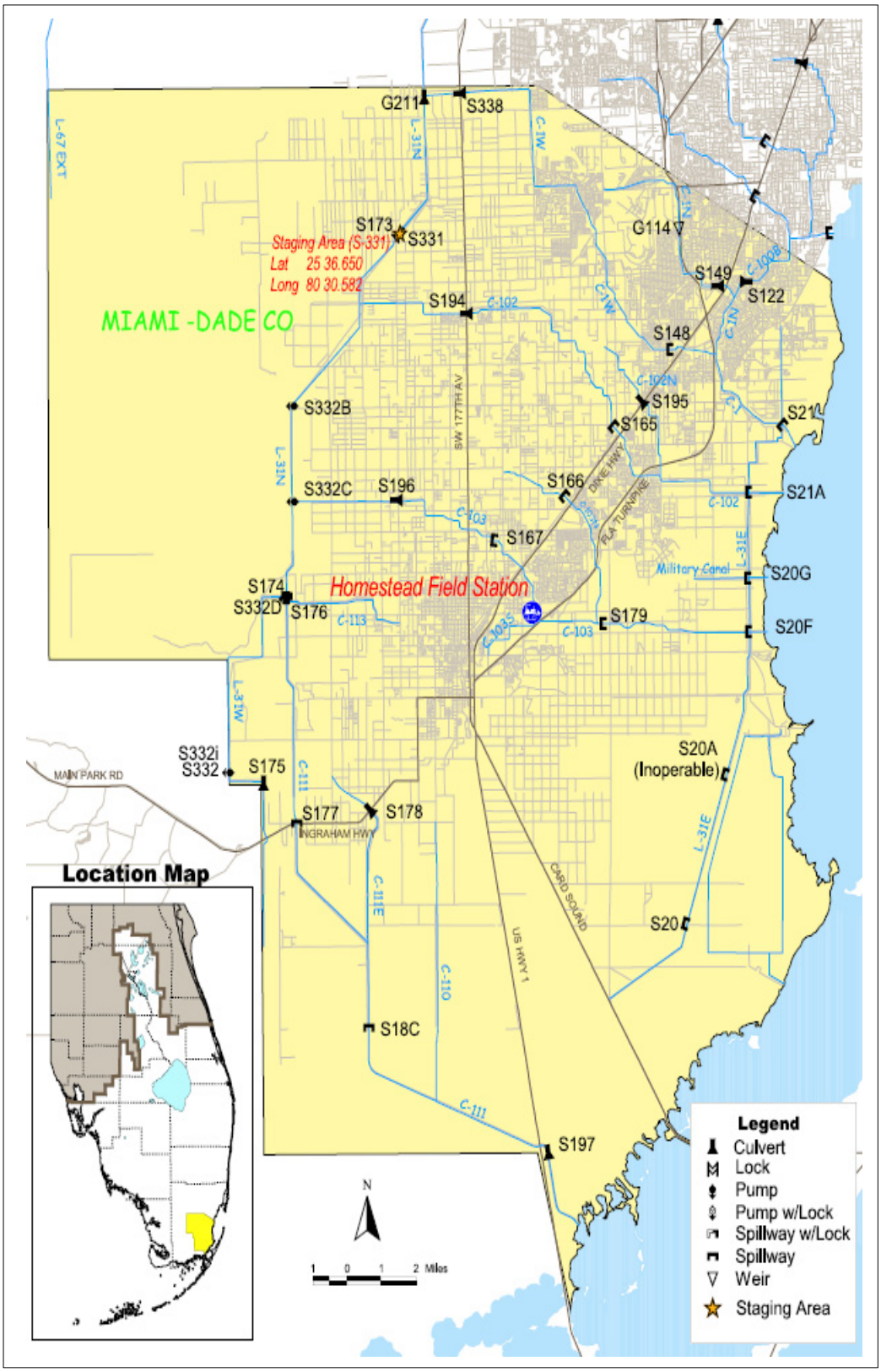


Figure 2. Major roads and canals within the C-111 Canal Project area.

METHODS

WATER QUALITY AND HYDROLOGIC DATA

The water quality and hydrologic data evaluated in this report are from the South Florida Water Management District's (SFWMD or District) DBHYDRO 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, 2007). The plan ensures that the water quality monitoring program provides accurate data.

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 a distance of 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 (TSP) of the CSOP that are within the authorization of the 1994 GRR (e.g., slight adjustment in the alignment of detention area levees). **Figure 3** shows the conceptual locations and configurations of the incomplete detention areas.

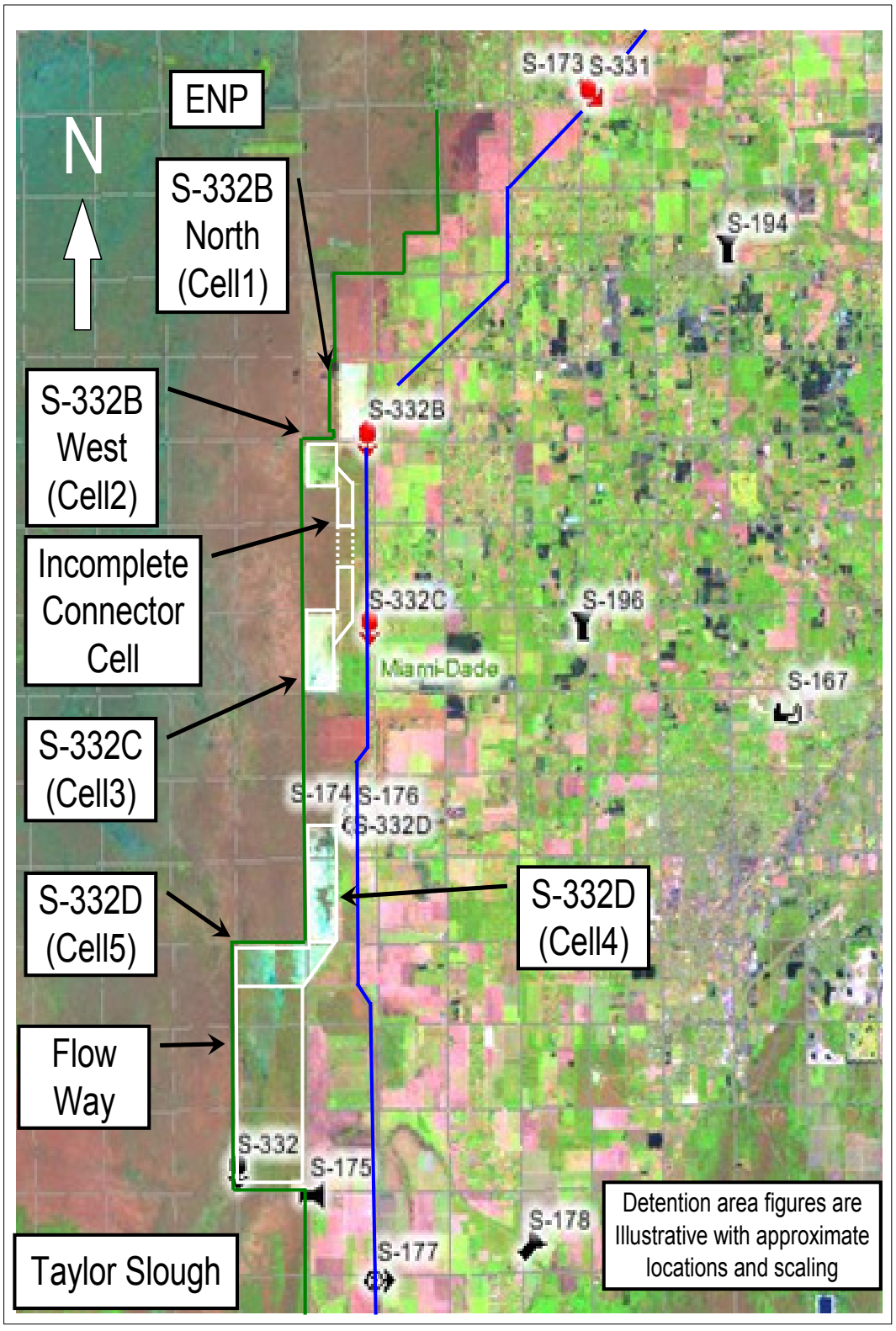


Figure 3. Location of S-332B, S-332C, and S-332D pump stations and detention areas.

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. Future modification of S-332D's high head cell will make northward flow possible when the S-332B and S-332C detention areas are 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 4** and **5** provide more detailed maps of the S-332B and S-332C facilities, respectively. The connector cell between S-332B and S-332C (**Figures 3**, **4**, and **5**) has not been completed due to delays in land acquisition.

Since the land swap (about 1,000 acres) between the SFWMD and the ENP was completed in March 2006, a continuous detention area will be constructed from S-332B west to S-332D as shown in **Figure 6**. This construction is expected to extend into August 2008. In addition, the connector cell will be constructed as a separate cell that receives 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 will create a continuous detention area from S-332B west through what is now the S-332C detention area. This expanded detention area will extend 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 will be constructed in a separate phase once the required land is acquired (**Figure 7**) 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 8**, **9**, and **10** illustrate the existing problem and solutions.

The S-332B north reservoir, renamed the S-332B north detention area, has been constructed. The connector cell and the raising of S-332B west's western levee and weir are not complete. However, to comply with the intent of the IOP for Protection of the CSSS, given the additional operational flexibility provided by completion of 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 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. In addition, substantive gaps in the detention areas due to the incomplete construction are expected to reduce the benefits, in terms of ground and surface water stages in the ENP, as groundwater will flow through these gaps.

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 depth of up to 4 ft for named storms (e.g., hurricanes, tropical storms, and tropical depression) and unnamed storms when the USACE determines that

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 described below:

- **S-332B north.** The S-332B north detention area currently 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 entire 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 currently covers approximately 160 ac and can receive flow from two of the four 125 cfs diesel pumps and one 75 cfs electrical pump located within the temporary S-332B pump station. The topsoil of this former agricultural land was scraped from the entire interior of the detention area and used for construction of the levees. This detention area initially became functional on April 17, 2000. It was taken off line 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 currently covers approximately 300 ac and can receive flow from the four 125 cfs diesel pumps and the one 75 cfs electrical pump located within the temporary S-332C pump station. The topsoil of this former agricultural land was scraped from the entire 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 was unable to build 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 because over 1,000 ac were owned by the ENP. To provide some of the completed project function, the USACE designed the connector cell located 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. The USACE was unable to construct the full connector cell because the SFWMD was unable to obtain the privately owned land in the central portion of the connector cell in the required time. 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 should be complete by the start of the 2008 wet season. The top soil of this former agricultural land was scraped from the entire

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 6**). Construction of the final detention area between S-332B west and S-332D was completed before the 2008 wet season. This detention area will receive 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 will extend from and include what are now the S-332B west and S-332C detention areas and end at the S-332D system. The final detention area will cover approximately 1,300 ac which is about 840 ac more than the 460 ac currently provided by S-332B west and S-332C detention areas.
- **Final detention area between S-332B north and the 8.5 SMA STA (Figure 7)**. Construction of the final detention area between S-332B north and the 8.5 SMA STA should be complete before the start of the 2009 wet season. 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 1,200 ac more than the 460 ac provided by S-332B north.

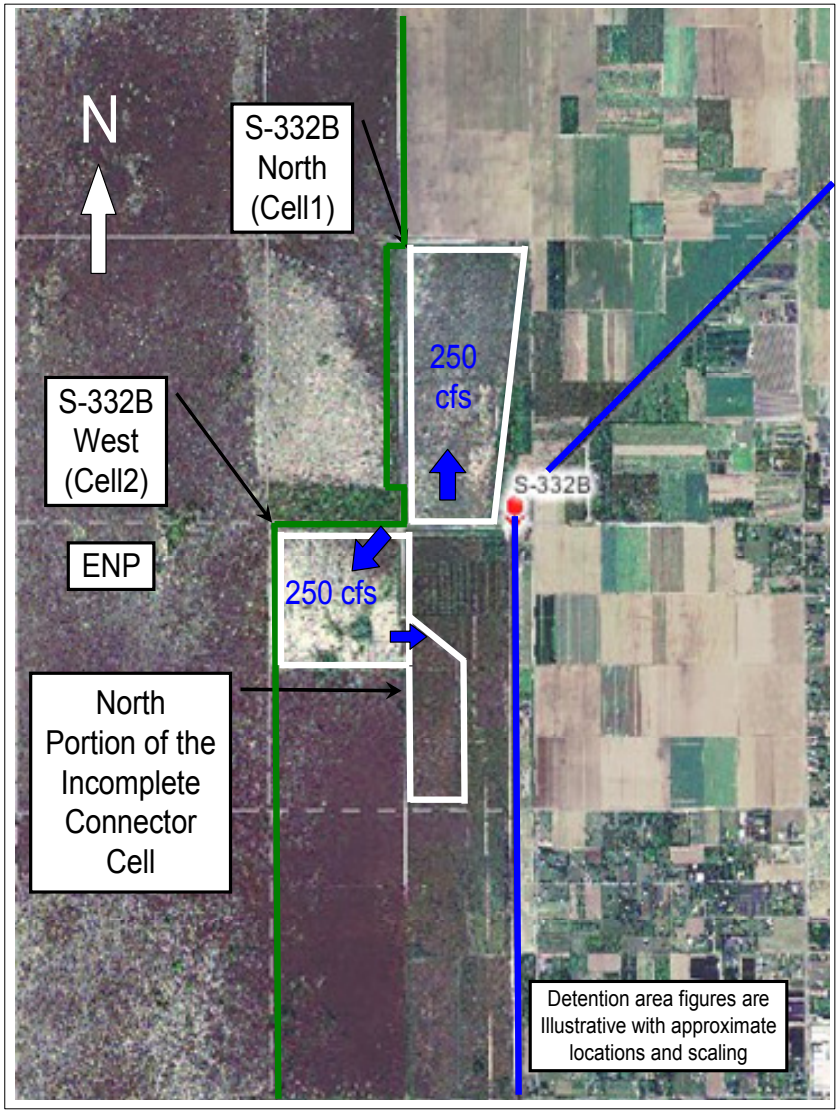


Figure 4. Location of S-332B pump stations and detention areas.

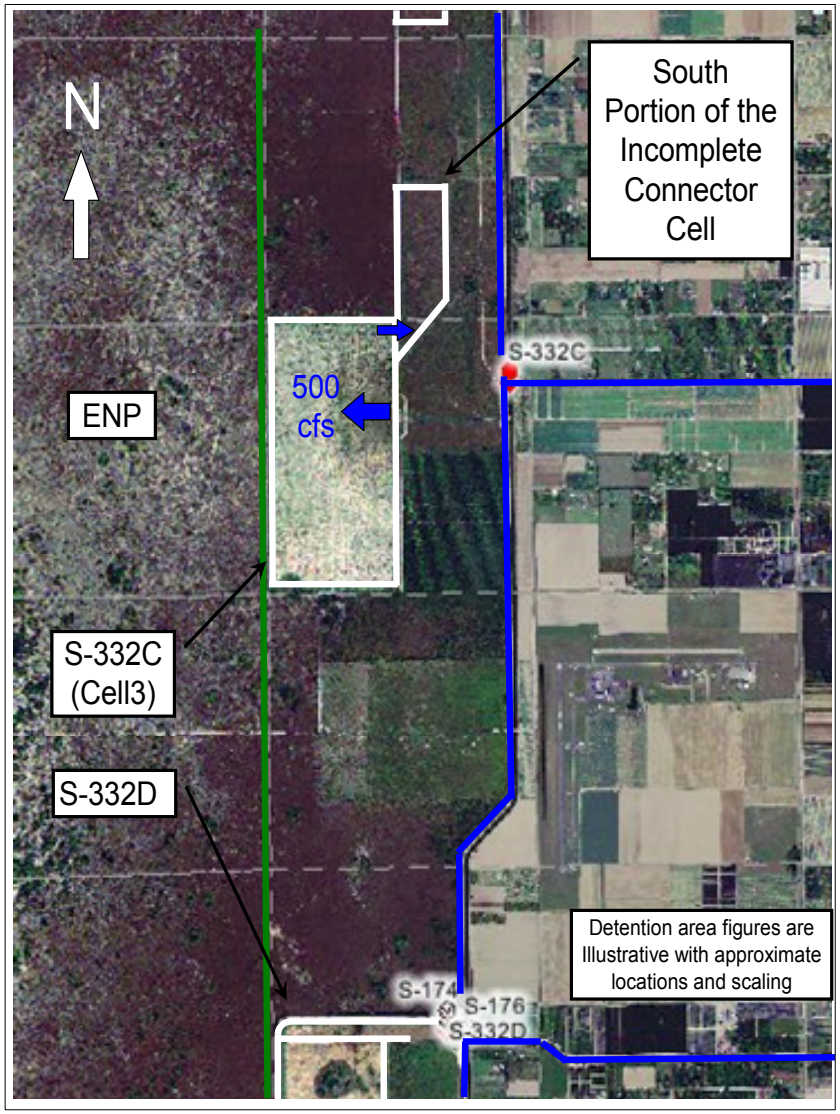


Figure 5. Location of S-332C pump stations and detention areas.

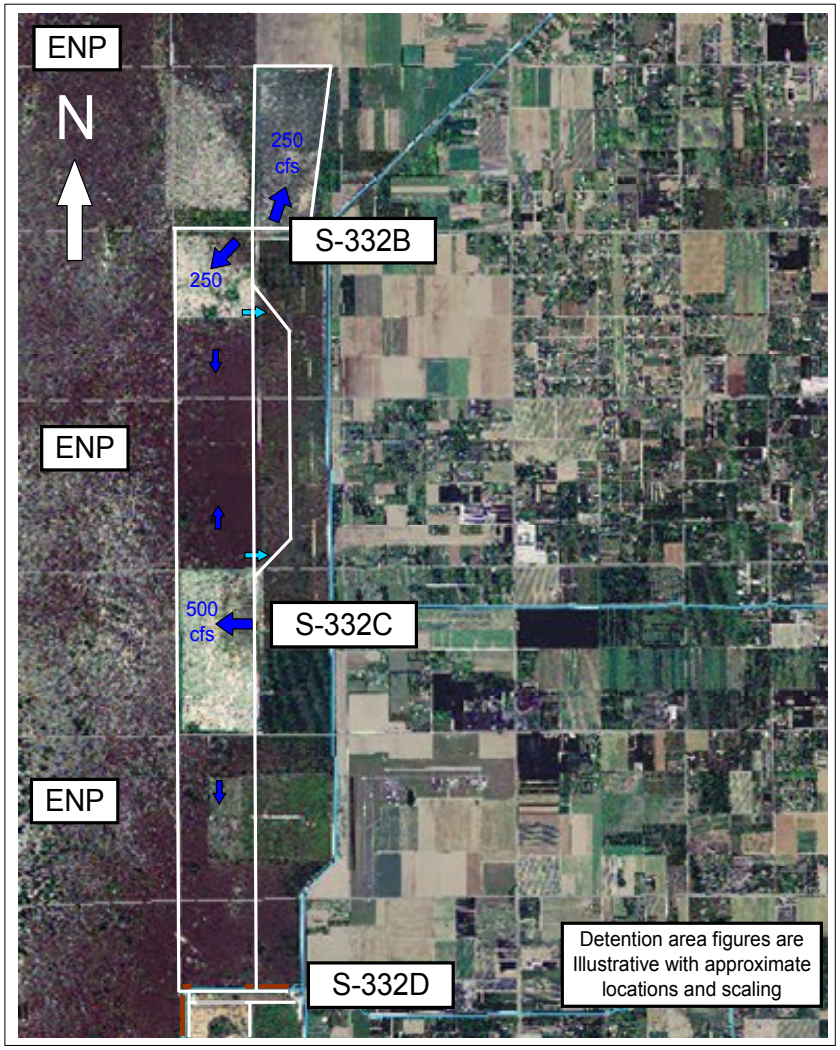


Figure 6. Location of S-332B, S-332C, and S-332D pumpstations and detention areas (south).

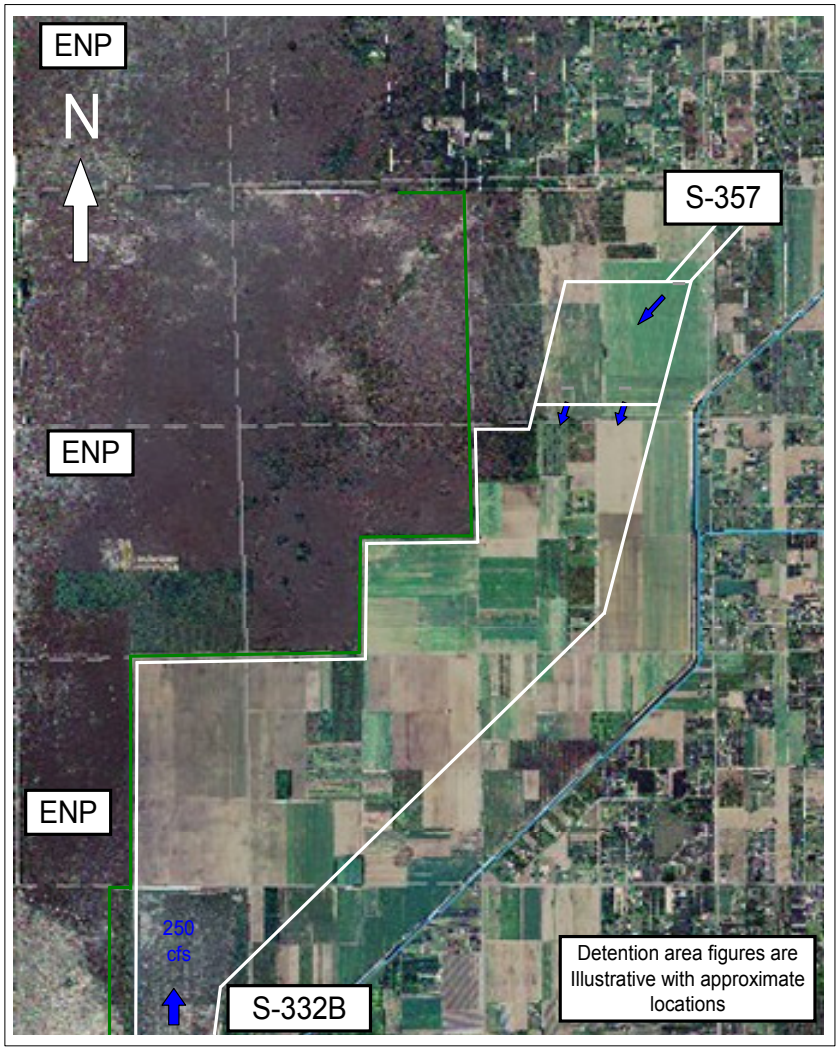


Figure 7. Location of S-332B pump station and detention area (north).

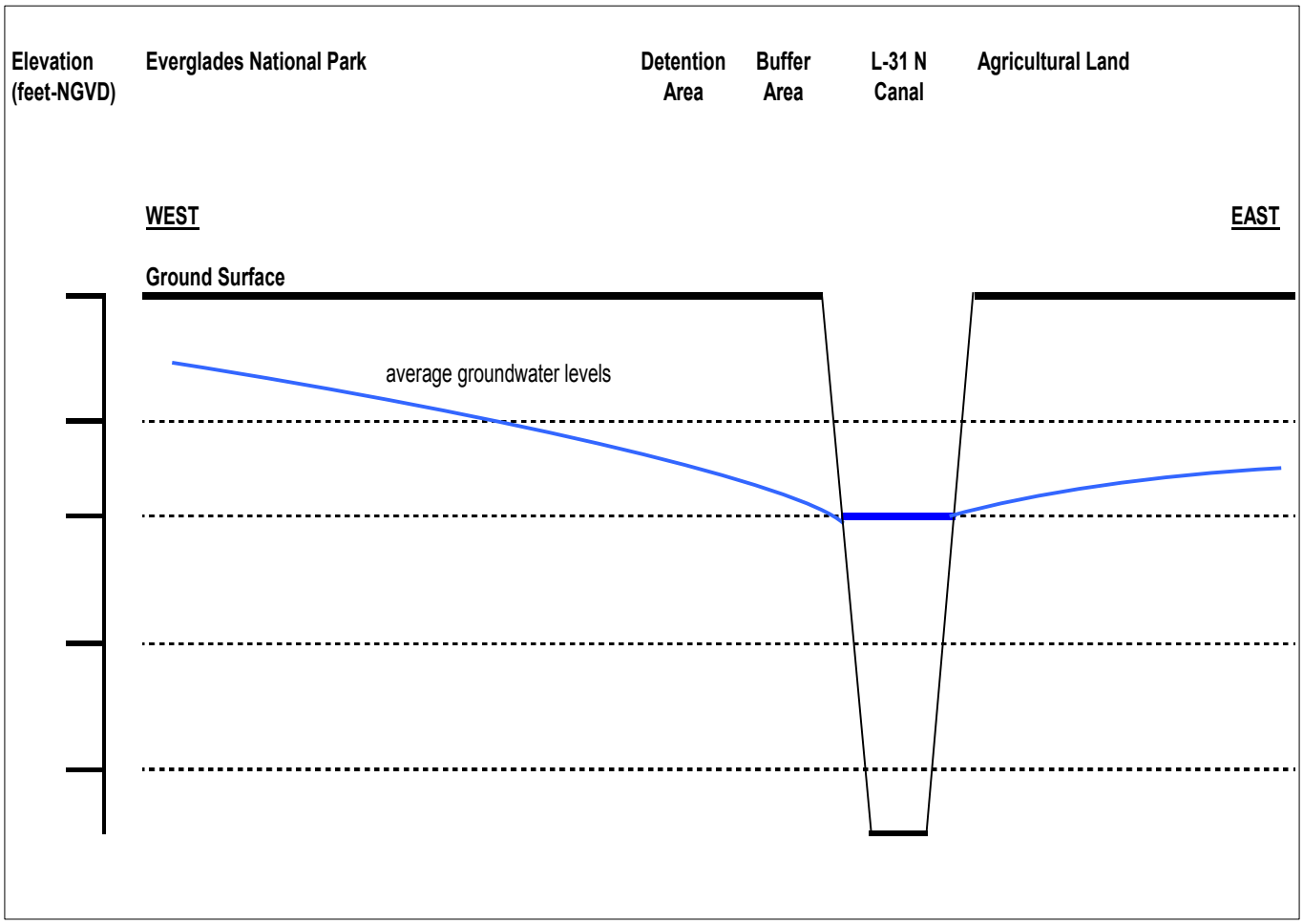


Figure 8. Generalization of groundwater flow near the L-31N canal without the project.

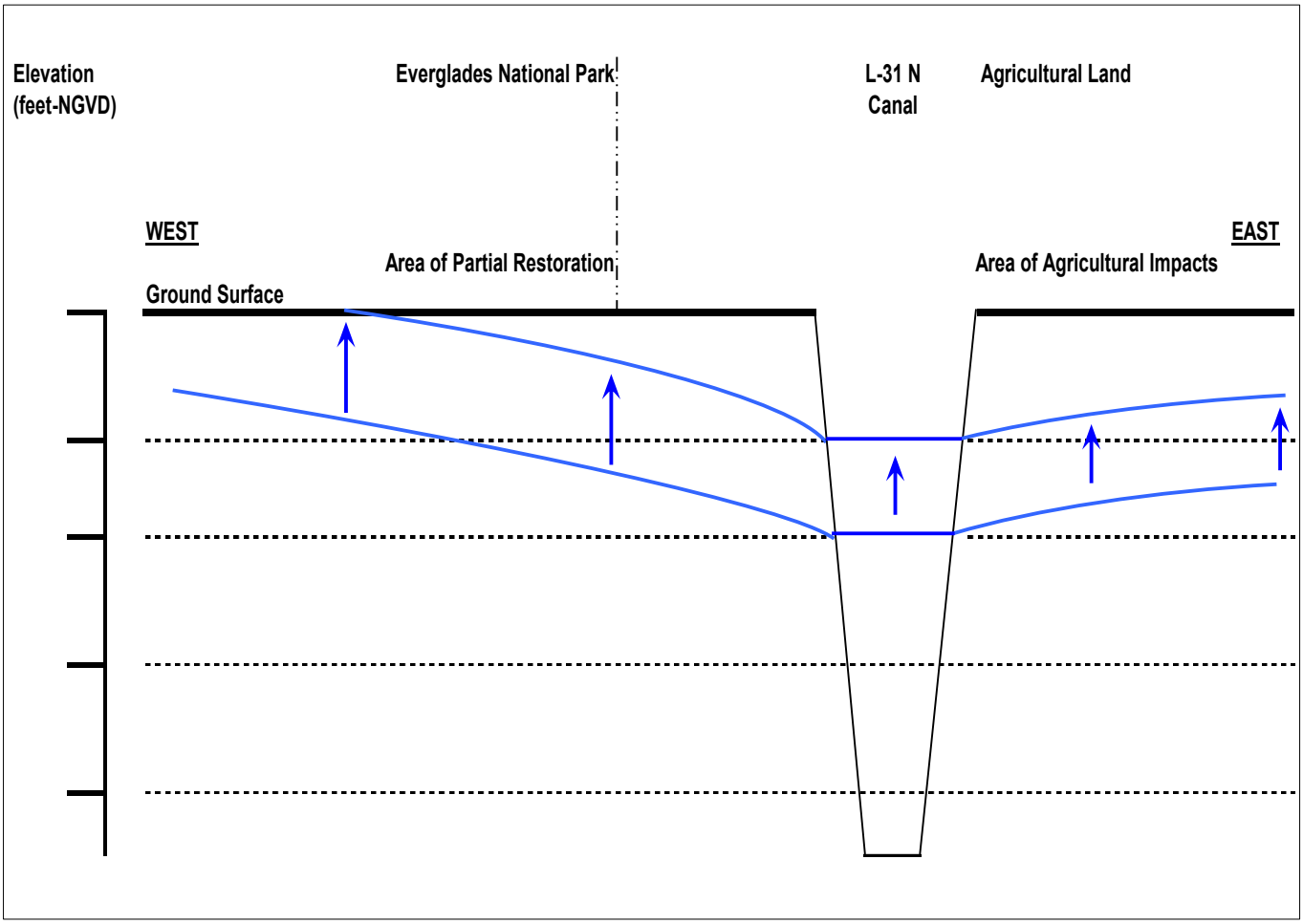


Figure 9. Illustration of potential impacts association with partial restoration without the detention area.

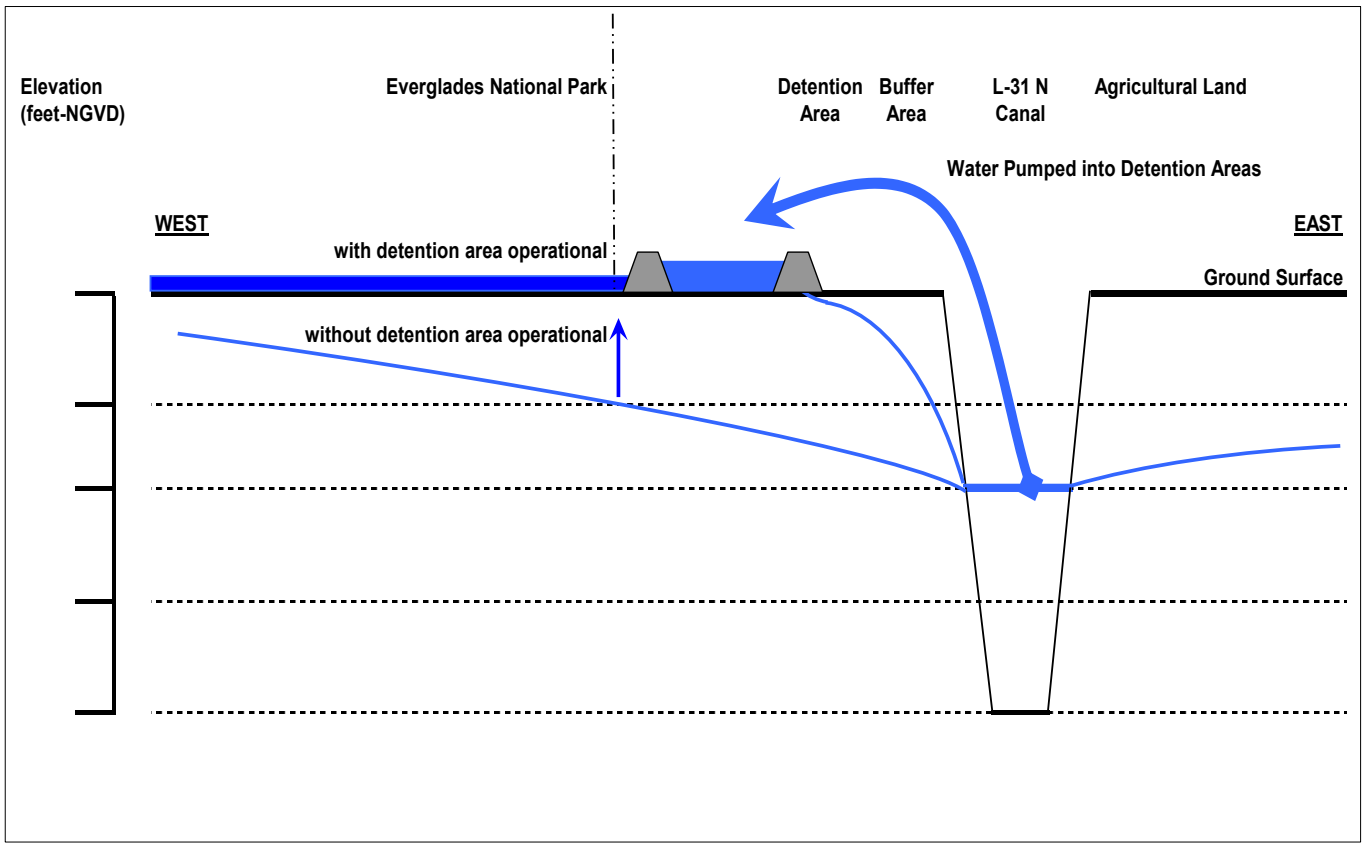


Figure 10. Generalization of groundwater flow near the L-31N canal with the detention area operational.

S-332D Detention Areas

The IOP for Protection of the CSSS allows surface water discharges into Taylor Slough during the CSSS nesting season: (1) maximum of 500 cfs from July 16 (or end of the breeding season, as confirmed by USFWS) to November 31, (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 11**, 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 (Frogpond) area came online. Detailed descriptions of the individual components of the S-332D detention system are below:

- **S-332D header cell** (**Figure 11**, panels a and b). The S-332D header cell covers approximately 39 ac, has an average bottom elevation of approximately 5.5 feet National Geodetic Vertical Datum 1929 (ft NGVD) and a 1,820-ft long discharge weir with a crest elevation of 8.2 ft NGVD. The top soil of this former agricultural land was scraped from the entire interior of the detention area and used for construction of the levees.
- **S-332D first detention area** (Cell 4 of **Figure 12**). The S-332D first detention area covers approximately 350 ac, has an average bottom elevation of approximately 5.3 ft NGVD, and an earthen berm acting as a broad crested weir with a top elevation of approximately 6.7 ft NGVD. With the notable exception of the tree island located within this detention area, the top soil of this former agricultural land was scraped from the entire interior and used for construction of the levees.
- **S-332D second detention area** (Cell 5 of **Figure 12**). The S-332D second detention area covers approximately 400 ac, has an average bottom elevation of 5.1 ft NGVD and a weir crest elevation of approximately 6.0 ft NGVD. The 1,900-ft long weir is constructed of concrete and discharges into the scraped portion of the flow-way. With the notable exception of the tree island located within this detention, the top soil of this former agricultural land was scraped from the entire interior of the detention area and used for construction of the levees.
- **S-332D flow-way** (flow-way of **Figure 12**). The flow-way covers approximately 1,300 ac and discharges through an approximately 2,000 ft-long levee gap located 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 NGVD. 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 NGVD, about a third of the land below 4.5 ft NGVD, and about 8 percent below 4.0 ft NGVD. 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.

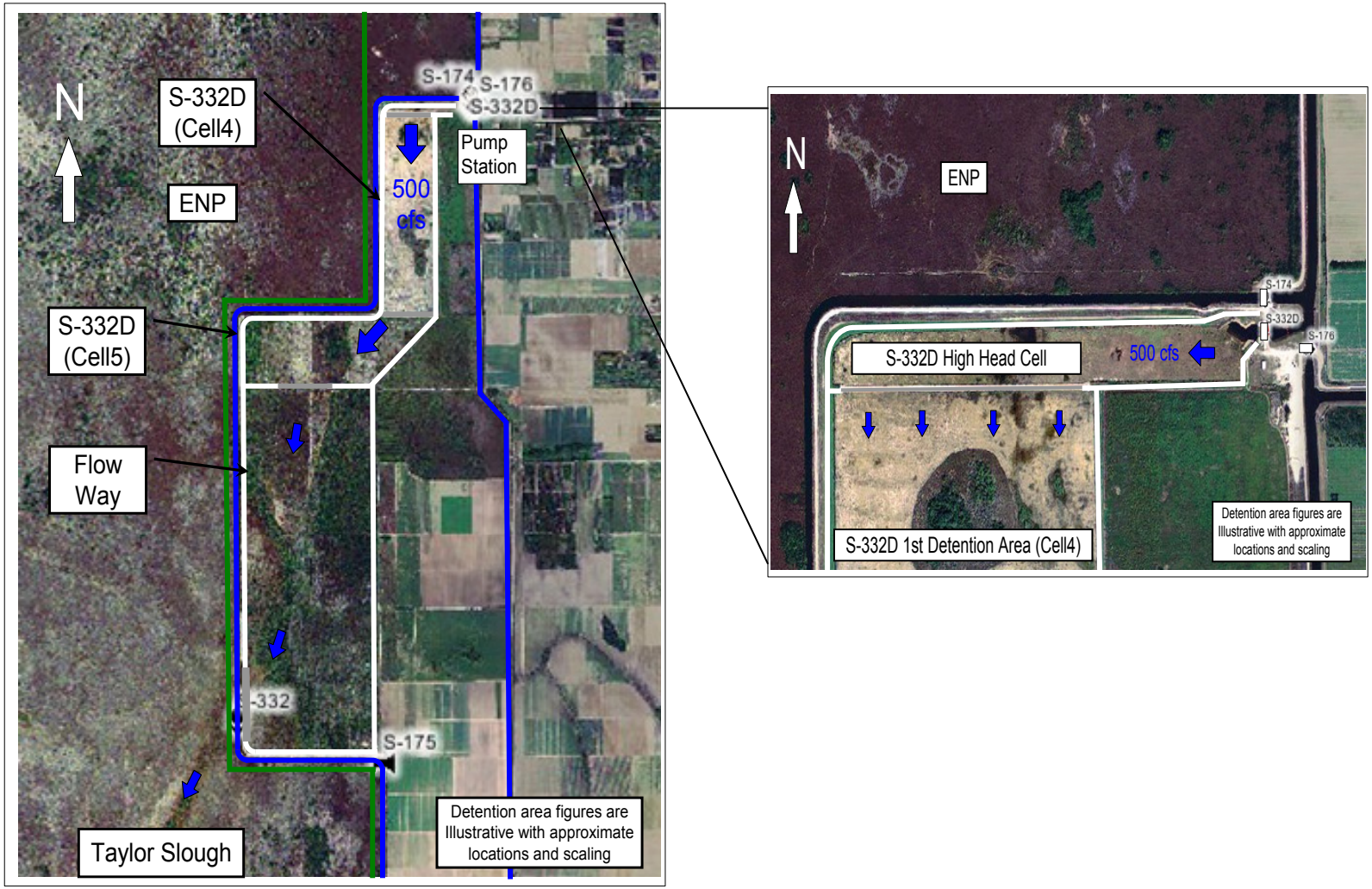


Figure 11. Location with flow arrows of S-33D pump station and detention areas (panel a), and a closer view of the S-332D pump station, high head cell, and first detention area (Cell 4) (panel b).

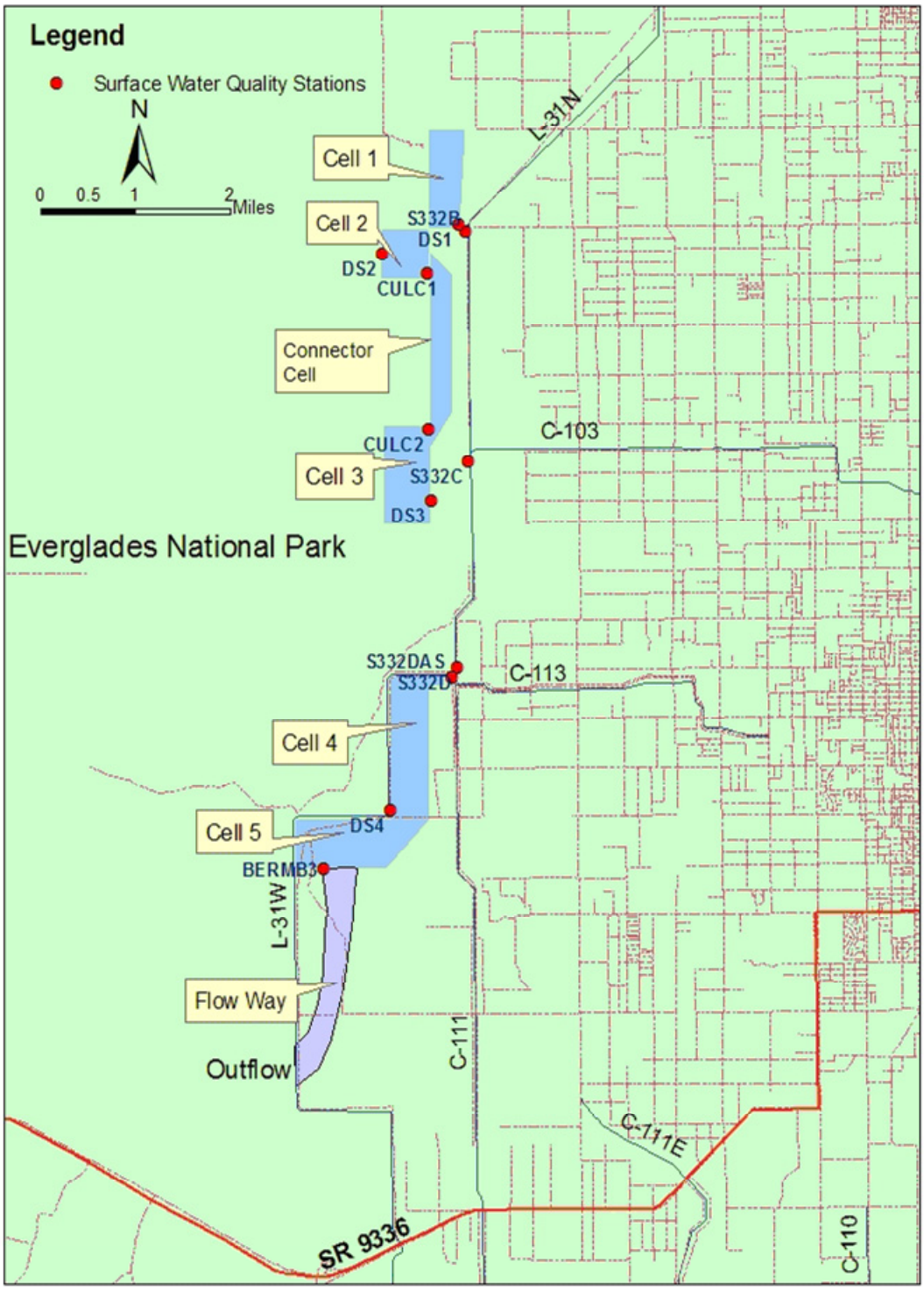


Figure 12. Monitoring locations and numbering for S-332B, S332C, and S-332D.

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 through 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 12**.

The DS1 and DS3 structures are the emergency overflow weirs for S-332B and S-332C, which 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 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. **Figure 12** shows structure locations for this project. 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, and 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 A, Table A-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 WY2008. 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, trace metal data reported to be less than the MDL were assigned a value equal to the MDL. Other data reported to be less than MDL were assigned values as follows:

- Total mercury data less than the MDL for total mercury [0.1 nanograms per liter (ng/L)] were assigned a value of 0.1 ng/L.
- Methylmercury data less than the MDL for methylmercury (0.022 ng/L) were assigned a value of 0.022 ng/L.
- Total phosphorus (TP) data that were less than the MDL of 2.0 micrograms per liter (µg/L) (or parts per billion [ppb]) were assigned a value of 2.0 ppb 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.

Trace Metals and Un-ionized Ammonia

The un-ionized portion of dissolved ammonia measured in a water sample was calculated and compared to the 0.02-milligrams per liter (mg/L) criterion only if temperature and pH values had been recorded for that sample.

For trace metals, the most recent trace metal criteria were used for evaluating the data even if the criteria had changed over time. When comparing the calculated criteria with trace metal concentrations, water samples were used only if hardness values were determined from that same sample (i.e., no extrapolations were made to samples without hardness data).

The equations used in this report for calculated criteria for trace metals and un-ionized ammonia were derived from the equations listed in Chapter 62-302.503, Florida Administrative Code (F.A.C.).

Total Phosphorus

Total phosphorus 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 phosphorus criterion for Class III waters in the EPA shall be a long-term geometric mean of 10 ppb, but shall not be lower than the natural conditions of the EPA, and shall take into account spatial and temporal variability (Chapter 62-302.540, 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-332, S-175, and 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 that 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.

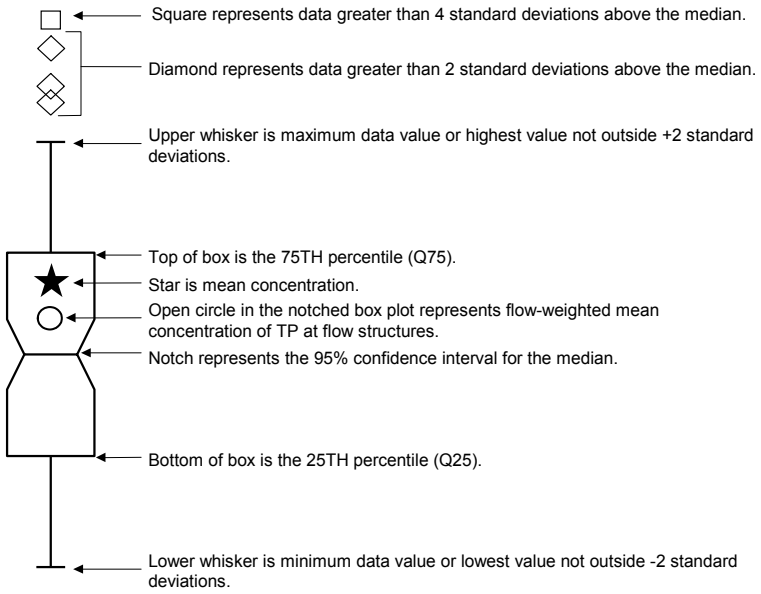
Mercury

The District collected unfiltered surface water samples at the three potential surface water inflow locations (S-332B, S-332C, and S-332D), the single outflow (BERMB3), and at two interior sites (CULC1 and CULC2) on a quarterly basis and analyzed for total mercury (THg), as stated in the monitoring plan. The District monitored water-column THg on an event basis, i.e., samples were collected if water was diverted from the detention areas (through one of four diversion structures) to the ENP. In addition to water-column THg, the District collected mosquitofish (*Gambusia holbrooki*) at CULC2, DS2, and DS4 (due to low water levels, the interior mosquitofish collection site CULC1 was replaced with CULC2 and outflow site BERMB3 was replaced by diversion sites DS2 and DS4) on an annual basis. Largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis* spp.) were eliminated from C-111D monitoring following the approved mandate modification in 2006. The District also collected surface water samples at four sites immediately downstream of the flow-way cell for THg determination and sediment samples at four downstream sites for mercury analysis. Surface water samples were not collected when total depth was less than 20 centimeters (cm) in WY2008.

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 13**).

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 WY2008 and future changes for the discharge structures. Notched box-and-whisker plots of total phosphorus and nitrogen (TP and TN) data for WY2008 are provided in Attachment B.



1.Notches surrounding the medians provide a measure of the significance of differences between notched box plots. If the notches about two medians do not overlap, then the medians are significantly different at about a 95-percent confidence level.
2.At times, the variability in a data set 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 automatically by the statistics program to save space within the figure being presented.
3.Notches are calculated using the following equation:

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

Where: n = number of data points

Figure 13. Description of notched box-and-whisker plots used in this appendix.

RESULTS: WATER QUALITY EVALUATION AND EXCURSION ANALYSIS

This section presents an update of constituent concentrations and physical properties measured during WY2008. For standards with numeric criteria, the data from the structures were assessed for compliance with those standards using the procedures in Chapter 62-4.246, F.A.C. 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, MAJOR IONS AND TRACE METALS

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 WY2008 is in Attachment C. A reference reflecting current state Class III criteria is provided in Attachment C, Table C-1. Attachment C, Table C-2 is a reference table for cross-referencing water quality monitoring sites with the C-111 EO #9 discharge structures. Attachment C, Table C-3, summarizes the descriptive statistics for each water quality parameter collected for all monitoring stations.

The statistical summary table (Table C-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 10 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 10 parameters listed in **Table 1**, only dissolved oxygen (DO) exhibited excursions during WY2008. A summary of observed excursions from Class III criteria for individual C-111 EO #9 monitoring locations during WY2008 is in **Table 2**. 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. When comparing the calculated criteria with trace metal or major ion concentrations, the only samples used were those for which hardness values were also determined. Other samples were excluded because hardness is needed to calculate Class III water quality criteria of trace metals.

For parameters that exceeded Class III criteria during WY2008, time series plots and box and whisker plots are provided in Attachment B. These plots report the range of the data and the magnitude of the excursions. They also assist with detecting whether there are any increasing or decreasing trends observed in the data.

Table 1. Summary of total number of excursions from state Class III criteria for all C-111 EO #9 monitoring sites.

PARAMETER	WY2008	2007	2006	2005	2004
Total Alkalinity	(0 : 2)	(0 : 5)	(0 : 10)	(0 : 20)	(0 : 11)
Dissolved Oxygen	**(88 : 144)**	**(84 : 141)**	**(110 : 128)**	**(144 : 173)**	**(121 : 129)**
Specific Conductance	(0 : 156)	(0 : 153)	(0 : 129)	(0 : 171)	(0 : 121)
pH	(0 : 156)	(0 : 153)	(0 : 131)	(0 : 174)	(0 : 130)
Turbidity	(0 : 31)	(0 : 39)	(0 : 68)	(0 : 104)	(0 : 69)
Un-Ionized Ammonia	(0 : 8)	(0 : 18)	(0 : 55)	(0 : 103)	(0 : 77)
Total Iron	(0 : 2)	(0 : 4)	(0 : 10)	(0 : 13)	(0 : 9)
Total Cadmium	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 6)
Total Copper	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 5)
Total Zinc	(0 : 0)	(0 : 1)	(0 : 11)	(0 : 11)	(0 : 6)

Notes: 1st number indicates number of excursions. 2nd number indicates total number of samples collected.

Table 2. Summary of excursions from state Class III surface water criteria for individual C-111 EO #9 monitoring sites during WY2008.

AREA	STRUCTURE	SAMPLING SITE	PARAMETERS									
			Alkalinity	DO	Specific Conductance	pH	Turbidity	Un-Ionized Ammonia	Iron	Cadmium	Copper	Zinc
Inflow	S332B	S332B	-ND-	**(34 : 47)**	(0 : 51)	(0 : 51)	(0 : 9)	-ND-	-ND-	-ND-	-ND-	-ND-
		S332BAuto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S332C	S332C	-ND-	**(29 : 48)**	(0 : 52)	(0 : 52)	(0 : 11)	-ND-	-ND-	-ND-	-ND-	-ND-
		S332CAuto	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-	-ND-
	S332D	S332D	(0 : 2)	**(11 : 18)**	(0 : 21)	(0 : 22)	(0 : 7)	(0 : 8)	(0 : 2)	-ND-	-ND-	-ND-
		S332DX	-ND-	**(13 : 30)**	(0 : 31)	(0 : 30)	(0 : 3)	-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-
Outfl	BERMB3	BERMB3	-ND-	**(1 : 1)**	(0 : 1)	(0 : 1)	(0 : 1)	-ND-	-ND-	-ND-	-ND-	-ND-
Totals			(0 : 2)	**(88 : 144)**	(0 : 156)	(0 : 156)	(0 : 31)	(0 : 8)	(0 : 2)	-ND-	-ND-	-ND-

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 was collected.

Dissolved Oxygen

Dissolved oxygen concentrations exhibited consistent excursions from Class III criteria during WY2008 (**Table 2**). About 61.1 percent (88 out of 144 samples) of DO concentrations measured at the C-111 EO #9 monitoring locations were less than the minimum criterion of 5 mg/L. The DO excursions occurred at all locations except for CULC1. The DO time-series and notched box-and-whisker plots are shown in Attachment B.

It should be noted that even unimpacted areas of the Everglades commonly have DO concentrations that are below the 5 mg/L standard as part of the natural water conditions found in South Florida. Because natural levels commonly fall below the existing standard, the FDEP has recently adopted a site-specific alternative criterion (SSAC) for DO in the EPA that better reflects naturally occurring conditions.

Total Dissolved Solids and Dissolved Organic Carbon

Sampling for total dissolved solids (TDS) and dissolved organic carbon (DOC) are required at inflow sites on a quarterly basis. DOC was proposed to be monitored monthly at the two interior structures; TDS, total organic carbon and DOC were proposed to be monitored when there is flow at the diversion structures.

The summary results for TDS for WY2008 are presented in Table C-4. The total dissolved solid was 309 mg/L in the surface water inflow sampled. No TDS were measured at the diversion structures and the outflow structure (BERMB3) during WY2008 because there was no flow at the diversion structures (DS1, DS2, DS3, and DS4) or at the outflow structure. The TDS varied from 176 to 346 mg/L in groundwater locations sampled, which is in the same range as in the surface water inflow.

The summary results for DOC for WY2008 are presented in Table C-5**.** DOC ranged from 7.5 to 24.0 mg/L in the surface water sampled at the inflow structures. There was no total organic carbon measured for the surface water sampled at the interior structures, the diversion structures, and the outflow structure (BERMB3) during WY2008 because there was no flow at these structures. There was very little variation in DOC concentrations among all structures.

Evaluation of Total Phosphorus

The C-111 EO #9 established the monitoring schedule shown in Attachment A 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 biweekly for the inflow and outflow structures, monthly for the interior structures, and in the event of diversion during flood events or to move water directly to the ENP from the diversion structures. Nutrients are the most frequently sampled parameters in this monitoring program.

During WY2008, auto-samplers (sampling regimes for S332B, S332C, and S332D are described in Table C-2 of Attachment C) collected TP samples weekly at the inflow structures S-332B, S-332C, and S-332D (water quality site ID S-332DAS changed to S-332DX for auto-sampler on October 2, 2007) pump stations. As shown in **Table 4**, no samples were collected at the two interior detention areas (CULC1 and CULC2) and four diversion structures (DS1, DS2, DS3, and DS4). One TP sample was collected at outflow site BERMB3.

The TP concentration data collected for all monitoring locations during WY2008 are plotted in time series and notched box and whisker plots in Attachment D, Figures D-1 to D-24. 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 µg/L) unless otherwise noted.

For WY2008, a statistical comparison of TP concentration data for all monitoring locations is presented as notched box-and-whisker plots in **Figure 14**. 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 C, Table C-3 (grab and auto-sampler data are reported separately). A discussion of the TP concentration data observed during WY2008 is provided in the following sections.

Inflow Structures

The TP concentrations for the C-111 EO #9 structures discharging directly to the detention areas during WY2008 varied around 10 ppb for all pump stations (**Figure 14**).

As shown in **Table 3**, 74 samples were collected by both grab and auto-samplers, with 26 flow events (a sample was collected when there was flow) at the S-332B site. At the S-332C site, 74 samples were collected by either grab or auto-samplers with 31 flow events. Grab and auto-samplers were used to collect 93 samples at the S-332D pump station (S332D, S332DAS, and S332DX) with 39 flow events.

As shown in Table C-3 of Attachment C, more than 75 percent of the TP data collected at the S-332B monitoring sites was below 8 ppb for both grab and auto-sampler, with a median value of 6 ppb for grab and 7 ppb for auto-sampler. More than 75 percent of the TP data collected at the S-332C monitoring sites was below 7 ppb (grab) and 8 ppb (auto-sampler), with a median value of 6 ppb for grab and 7 ppb for auto-sampler. Discharge data monitored at pump stations during WY2008 [26,499 acre-feet (ac-ft) for S-332B and 49,156 ac-ft for S-332C, respectively] indicates 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 7 ppb (grab) and 11 ppb (auto-sampler), with median concentrations of 6 ppb for grab and 8 ppb for auto-sampler samples. During WY2008, structure S-332D discharged 32,689 ac-ft to the detention area.

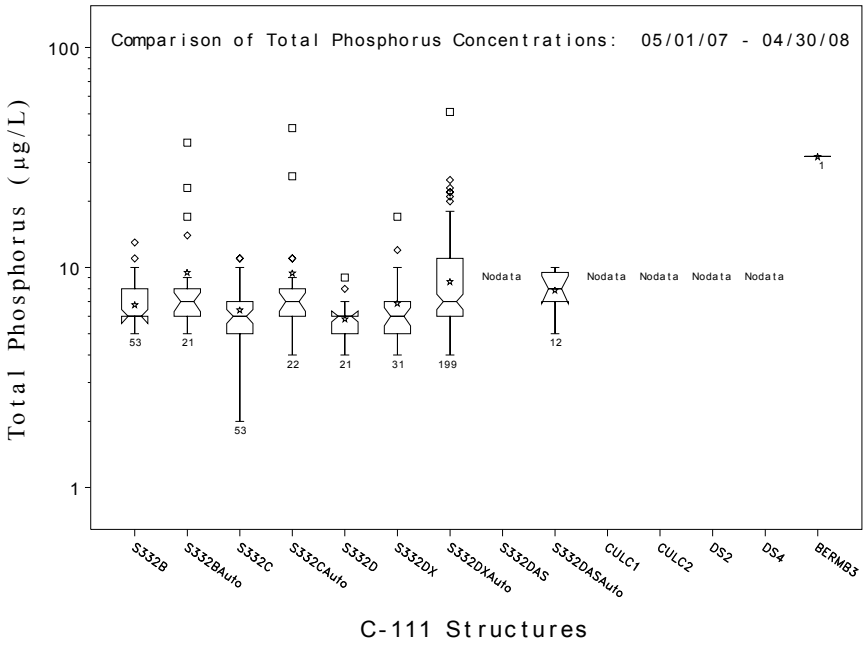


Figure 14. Comparison of TP concentrations for C-111 canal structures.

Table 3. Flow volumes and flow-weighted mean TP concentrations of surface water during WY2008.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet)	Sample Size (Grab)	Number of Days with Positive Flow	Arithmetic Average (Grab)(µg/L)	Sample Size (Comp)	Sample Type	Total Samples Collected During Flow	Flow-Weighted Mean Concentration (µg/L)	TP Load (kg)
Inflow	S332B	S332B	26,499	53	99	6.8	21	Auto [3] & Grab [2]	26/74 [5]	7.6	248
	S332C	S332C	49,156	51	122	6.4	23	Auto [3] & Grab [2]	31/74	7.1	433
	S332D	S332D, S332DAS & S332DX	32,689	52	134	6.5	41	Auto [3] & Grab [2]	39/93	6.5	262
Interior	C1	CULC1	0	0	N/D	N/D	N/D	Grab [2]	0/0	N/F	N/F
	C2	CULC2	0	0	N/D	N/D	N/D	Grab	0/0	N/F	N/F
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	1	N/D	32.0	N/D	Auto [3] & Grab [2]	0/1	N/F	N/F

Notes:

1) N/D no data available
2) Grab indicates samples collected by grab sampling methodology.
3) Auto indicates that samples were collected by automatic composite samples.
4) N/F - no flow.
5) 26/74 indicates 26 samples collected during flow events among 74 total collected samples

Interior Structures

As shown in **Table 3**, there was no flow for the two interior structures (CULC1 and CULC2) and no samples were collected at CULC1 and CULC2 in WY2008. Therefore, no TP data were collected at CULC1 or CULC2.

Diversion Structures

As shown in **Figure 12**, 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 WY2008, there were no flow data from the detention area to the ENP via the BERMB3 structure. One TP sample was collected at BERMB3 with a concentration of 32.0 ppb (see Table C-3). Flow rarely occurs over BERMB3 due to the high seepage rates.

Flow-Weighted Mean TP Concentrations for All Structures

Flow-weighted mean (FWM) TP concentrations were calculated for each of the structures for WY2008. The 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 WY2008.

The FWM TP concentrations and the annual and quarterly flow volumes for the inflow and outflow structures during WY2008 are provided in Attachment A, Table A-2.

Table 3 presents the results for the FWM TP concentrations at inflow sites during WY2008. The FWM TP concentration for all the inflow structures during WY2008 was very similar, with 7.6 ppb at the S-332B, 7.1 ppb at the S-332C, and 6.5 ppb at the S-332D pump stations. FWM TP concentrations were below 10 ppb at all inflow structures. 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 WY2008, auto-samplers collected TN samples weekly at the S-332B and S-332C pump structures. Deployment of the auto-samplers at these locations was previously identified as an improvement in the monitoring program for collecting TN data at inflow structures. Auto-samplers also collected samples at the S-332D structures located in the C-111 basin that discharge water into the S-332D detention area east of the ENP. Samples were collected from the auto-sampler at S-332DAS site and new sample ID S332DX has been used since October 2, 2007.

The TN concentration data collected for all monitoring locations during WY2008 are plotted in time-series and notched box-and-whisker plots in Attachment D, Figures D-25 through D-42. 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 mg/L) unless otherwise noted.

For WY2008, a statistical comparison of TN concentration data for all monitoring locations is presented as notched box-and-whisker plots in **Figure 15**. The figure represents inflow. Summary statistics of TN data collected for all monitoring locations are presented as a separate table in Attachment C, Table C-3 (grab and auto-sampler data are reported separately). A discussion of the TN concentration data observed during WY2008 is provided in the following sections.

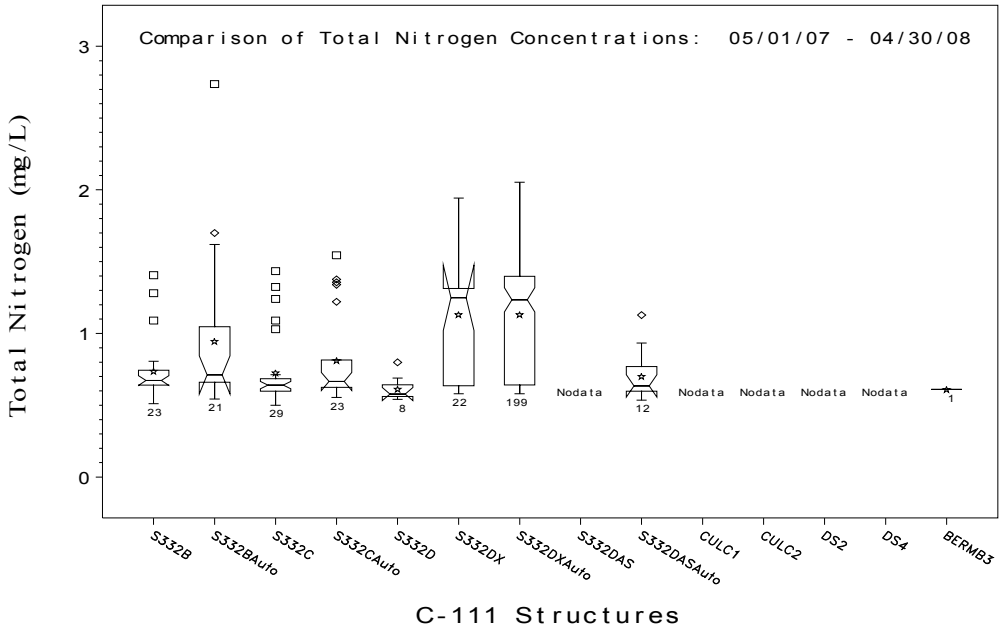


Figure 15. Comparison of TN concentrations for C-111 canal structures.

Inflow Structures

There was a similar average TN concentration in grab samples for all inflow structures (0.742 mg/L for S-332B, 0.720 mg/L for S-332C, and 1.003 mg/L for S-332D) discharging into the detention area during WY2008 (**Table 4** and **Figure 15**). 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 as shown in Table C-2.

As shown in Table C-3 of Attachment C, more than 75 percent of the TN data collected at the S-332B monitoring site were below 0.744 mg/L (grab) and 1.047 mg/L (auto-sampler), with median values of 0.672 mg/L (grab) and 0.711 mg/L (auto-sampler). More than 75 percent of the TN data collected at the S-332C monitoring site were below 0.685 mg/L (grab) and 0.815 mg/L (auto-sampler), with median values of 0.640 mg/L (grab) and 0.665 mg/L (auto-sampler).

Interior Structures

As shown in **Table 4**, there was no flow for the two interior structures (CULC1 and CULC2) so no TN grab samples were collected at those sites during WY2008.

Diversion Structures

As shown in **Table 4**, there was no flow for the four diversion structures (DS1, DS2, DS3, and DS4). As a result, no samples were collected from any of the diversion structures during WY2008.

Table 4. Flow-weighted mean TN concentrations of surface water in WY2008.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet)	Sample Size (Grab)	Number of Days with Positive Flow	Arithmetic Average (Grab)(mg/L)	Sample Size (Comp)	Sample Type	Total Samples Collected During Flow	Flow-Weighted Mean Concentration (mg/L)	TN Load (kg)
Inflow	S332B	S332B	26,499	21	99	0.742	21	Auto [3] & Grab [2]	24/42 [5]	0.891	29,130
	S332C	S332C	49,156	27	122	0.720	23	Auto [3] & Grab [2]	31/50	0.671	40,655
	S332D	S332D, S332DAS and S332DX	32,689	30	134	1.003	41	Auto [3] & Grab [2]	32/71	0.668	26,954
Interior	C1	CULC1	0	0	0	N/D	N/D	Grab [2]	N/F[4]	N/F	N/F
	C2	CULC2	0	0	0	N/D	N/D	Grab	N/F	N/F	N/F
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	1	N/D	0.610	N/D	Auto [3] & Grab [2]	0/1	N/F	N/F

Notes:

1) N/D no data available
2) Grab indicates samples collected by grab sampling methodology.
3) Auto indicates that samples were collected by automatic composite samples.
4) N/F - no flow.
5) 24/42 indicates 24 samples collected during flow events among 42 total collected samples

Outflow Structures

BERMB3 is the only outflow structure to the ENP. During WY2008, there were no discharges from the detention area to the ENP through the BERMB3 structure. One outflow TN sample was collected from the upstream (north) side of the berm. This sample had a TN concentration of 0.610 mg/L.

Flow-Weighted Mean TN Concentrations for All Structures

Flow-weighted mean TN concentrations were calculated for all inflow structures during WY2008. The 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 TN concentrations was accomplished for structures having sufficient TN and flow data for WY2008.

The FWM TN concentration and monthly and quarterly flow volumes for the inflow, interior, diversion, and outflow structures during WY2008 are provided in Attachment A, Table A-3.

A more detailed analysis of WY2008 FWM TN concentrations for each inflow structure is shown in **Table 4**. Similar FWM TN concentrations were observed at all inflow structures (0.891 mg/L for S-332B, 0.671 mg/L for S-332C, and 0.668 mg/L for S-332D pump station).

GROUNDWATER QUALITY

The groundwater monitoring sites are shown in **Figure 16**. As shown in **Table 5**, the TP concentrations were less than 10 ppb at all 10 groundwater wells except S332CED, where TP concentration was sufficiently high for concern (91.3 ppb or µg/L). However, this may be an anomaly since the TP concentrations in the wells east of the detention areas (S332BES, S332BED, S332DES, and S332DED) are considerably lower than S332CED and the groundwater flows to the east when the detention areas are receiving flow. This means the high TP levels at S332CED may indicate either direct runoff into the well (e.g., improperly sealed casing) or the introduction of surface water via an adjacent agriculture well. The well and adjacent area were inspected in August 2008. In addition, a casing seal of grout was installed on the well (S332CED) and the well was redeveloped in case the TP concentration is the result of surface water being introduced.

Figure 16. Monitoring locations and numbering for S-332B, S-332C, and S-332D.

Table 5. Average TP concentrations of groundwater during WY2008.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab)(µg/L or ppb)	Sample Type	TP Load (kg)
Groundwater	S332B	S332BED[1]	26,499	4	6.0	Grab [2]	127
		S332BES		4	6.0	Grab [2]	
		S332BWD		4	6.3	Grab [2]	
		S332BWS		4	5.3	Grab [2]	
	S332C	S332CED	49,156	4	91.3	Grab [2]	1,164
		S332CES		4	8.8	Grab [2]	
		S332CWD		4	9.3	Grab [2]	
		S332CWS		4	7.5	Grab [2]	
	S332D	S332DED	32,689	4	5.3	Grab [2]	160
		S332DES		4	6.3	Grab [2]	
		S332DWD		4	7.3	Grab [2]	
		S332DWS		4	5.3	Grab [2]	

Notes:

1) S332BED: S332B=station name; E=east; W=west; D=deep and S=shallow.

2) Grab indicates samples collected by grab sampling methodology.

3) 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

4) 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 relase or sediment adsorption

As shown in **Table 6**, TN ranged from 0.096 to 0.753 mg/L. TN concentrations are less than 1 mg/L, which is similar to or slightly lower than the TN in surface water (from 0.742 to 1.003 mg/L as shown in **Table 4**). Water quality data for WY2008 will be available on request.

The TP and TN mass balances (**Tables 3** through **6**) 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
- rainfalls equal to or exceeding evapotranspiration
- net inflow (all inflows minus outflows) provides a reasonable estimate of seepage

The following assumptions were made for mass balance:

- rainfalls equal to or exceeding evapotranspiration
- rainfall contains no TP
- net inflow (all inflows minus outflows) is lost to seepage to groundwater

As shown in **Table 3**, the flow pumped into the detention areas contained 248 kilograms (kg) of TP at S-332B, 433 kg of TP at S-332C, and 262 kg of TP at S-332D. These numbers assume that the rain contains no TP. 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 **Table 3** and **Table 5**, the average inflow (pumped) TP concentrations ranged from 6.5 to 7.6 ppb whereas the average concentration in the western wells ranged from 5.3 to 9.3 ppb, and the average concentration in the eastern wells, with the notable exception of S332CED, ranged from 5.3 to 8.8 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 4**, the inflow (pumped) TN load was 29,130 kg at S-332B, 40,655 kg at S-332C, and 26,954 kg at S-332D respectively. The average inflow (pumped) TN concentrations ranged from 0.720 to 1.003 mg/L (**Table 4**) whereas the average concentration in the western wells ranged from 0.514 to 0.753 mg/L and the average concentration in the eastern wells ranged from 0.096 to 0.638 mg/L (**Table 6**). The TN concentrations in wells were generally slightly lower than TN concentrations of inflow structures.

Table 6. Average TN concentrations of groundwater during WY2008.

Type	Structure	Water Quality Station Id	Total Flow Volume (acre-feet) [3]	Sample Size (Grab)	Arithmetic Average (Grab)(mg/L)	Sample Type	TN Load (kg)
Groundwater	S332B	S332BED[1]	26,499	4	0.638	Grab [2]	14,739
		S332BES		4	0.612	Grab [2]	
		S332BWD		4	0.753	Grab [2]	
		S332BWS		4	0.744	Grab [2]	
	S332C	S332CED	49,156	4	0.096	Grab [2]	20,034
		S332CES		4	0.622	Grab [2]	
		S332CWD		4	0.652	Grab [2]	
		S332CWS		4	0.643	Grab [2]	
	S332D	S332DED	32,689	4	0.576	Grab [2]	15,486
		S332DES		4	0.603	Grab [2]	
		S332DWD		4	0.648	Grab [2]	
		S332DWS		4	0.514	Grab [2]	

Notes:

1) S332BED: S332B=station name; E=east; W=west; D=deep and S=shallow.

2) Grab indicates samples collected by grab sampling methodology.

3) 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

4) 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 relase or sediment adsorption

Pesticide Monitoring

A modification was implemented on September 10, 2007, to eliminate pesticide monitoring at S332B and S332C sites and use S331–S173 as a surrogate pesticide monitoring site for the S332B and S332C. The results of the quarterly surface water pesticide sampling events are presented in **Table 7.** The detected concentrations of endosulfan (alpha and/or beta) do not exceed the F.A.C. Chapter 62-302 Class III surface water standard (0.056 µg/L). 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 (USEPA, 2003). The two atrazine surface water concentrations detected (0.081 µg/L and 0.96 µg/L) should not have an acute or chronic detrimental impact on fish or invertebrates.

Table 7. Quarterly pesticide detections for WY2008.

			Compound (µg/L)					
Sampling Date	**Flow**	**Site**	**ametryn**	**atrazine**	**atrazine desethyl**	**atrazine desisopropyl**	**alpha endosulfan**	**beta endosulfan**
May 14, 2007	no	BERMB3[1]	-	-	-	-	-	-
	no	S331	BDL	BDL	BDL	BDL	BDL	BDL
September 10, 2007	yes	S332DX	BDL	BDL	BDL	BDL	BDL	BDL
	yes	S331	BDL	BDL	BDL	BDL	BDL	BDL
December 10, 2007	no	S332DX	BDL	BDL	BDL	BDL	0.029	0.0078 I
	no	S331	BDL	BDL	BDL	BDL	BDL	BDL
March 17, 2008	no	S332DX	0.018 I	0.081	0.035 I	0.0096 I	0.018	0.0062 I
	no	S331	0.031 I	0.96	0.047	0.012 I	BDL	BDL

[1]no sample obtained, site dry

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

BDL: below method detection limit

To evaluate the potential impacts on aquatic life, the observed concentration is compared to the appropriate criterion outlined in Subsection 62-302.530 F.A.C. If a pesticide compound is not specifically listed, acute and chronic toxicity criterion are 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 EC_{50} or LC_{50} reported in the summarized literature for the species significant to the indigenous aquatic community (Subsection 62-302.200 F.A.C.) (**Table 8**).

The highest ametryn surface water concentrations found was 0.031 µg/L. Using these criteria, these observed surface water concentrations should not have an acute, detrimental impact on fish or aquatic invertebrates (**Table 8**).

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 (USEPA, 2003). The highest atrazine surface water concentrations detected (0.96 µg/L) should not have an acute or chronic detrimental impact on fish or invertebrates (**Table 8**).

Atrazine desethyl (DEA) and atrazine desisopropyl (DIA) are biotic degradation products of atrazine. These degradation products are both persistent and mobile in water; however, DEA is more stable and the dominant initial metabolite. Since DEA and DIA are structurally and toxicologically similar to atrazine, the concentrations of total atrazine residue (atrazine + DEA + DIA) may also be a significant consideration in the surface water environment. However, neither Subsection 62-302.530 F.A.C. criteria nor toxicity information are available to make a determination of environmental impact.

Table 8. Toxicity of pesticides detected to freshwater aquatic invertebrates and fishes (µg/L).

	48 hr EC_{50}				96 hr LC_{50}				96 hr LC_{50}				96 hr LC_{50}				96 hr LC_{50}				96 hr LC_{50}			
	Water flea[#] (*Daphnia magna*)		acute toxicity *	chronic toxicity*	**Fathead Minnow**[#] (*Pimephales promelas*)		acute toxicity	chronic toxicity	**Bluegill** (*Lepomis macrochirus*)		acute toxicity	chronic toxicity	**Largemouth Bass** (*Micropterus salmoides*)	acute toxicity	chronic toxicity	**Rainbow Trout**[#] (*Oncorhynchus mykiss*)		acute toxicity	acute toxicity	**Channel Catfish** (*Ictalurus punctatus*)		acute toxicity	acute toxicity
ametryn	28,000	(6)	9,333	1,400	-		-	-	4,100	(4)	1,367	205	-	-	-	8,800	(4)	2,933	440	-		-	-
	-		-	-	-		-	-	-		-	-	-	-	-	3,600	(7)	1,200	180	-		-	-
atrazine	6,900	(6)	2,300	345	15,000	(6)	5,000	750	16,000	(4)	5,333	800	-	-	-	8,800	(4)	2,933	440	7,600	(4)	2,533	380
	-		-	-	-		-	-	-		-	-	-	-	-	5,300	(8)	1,767	265	-		-	-
endosulfan	166	(6)	55	8	1	(1)	0.3	0.05	1	(1)	0.33	0.05	-	-	-	1	(1)	0.33	0.050	1	(1)	0.3	0.05
	-		-	-	-		-	-	2	(3)	0.67	0.10	-	-	-	3	(2)	1	0.15	1.5	(7)	0.5	0.08
	-		-	-	-		-	-	-		-	-	-	-	-	1	(3)	0.33	0.050	-		-	-
	-		-	-	-		-	-	-		-	-	-	-	-	0.3	(5)	0.10	0.015	-		-	-
	166	(9)	55	8	1.5	(11)	0.5	0.08	1.7	(9)	0.57	0.09	-	-	-	0.8	(9)	0.27	0.04	-		-	-

(*) 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.

(#) Species is not indigenous. Information is given for comparison purposes only.

(1) Johnson, W. W. and M.T. Finley (1980).
(2) U.S. Environmental Protection Agency (1977).
(3) Schneider, B.A. (Ed.) (1979).
(4) Hartley, D. and H. Kidd. (Eds.) (1987).
(5) Montgomery, J.H. (1993).
(6) U.S. Environmental Protection Agency (1991).
(7) U.S. Environmental Protection Agency (2005).

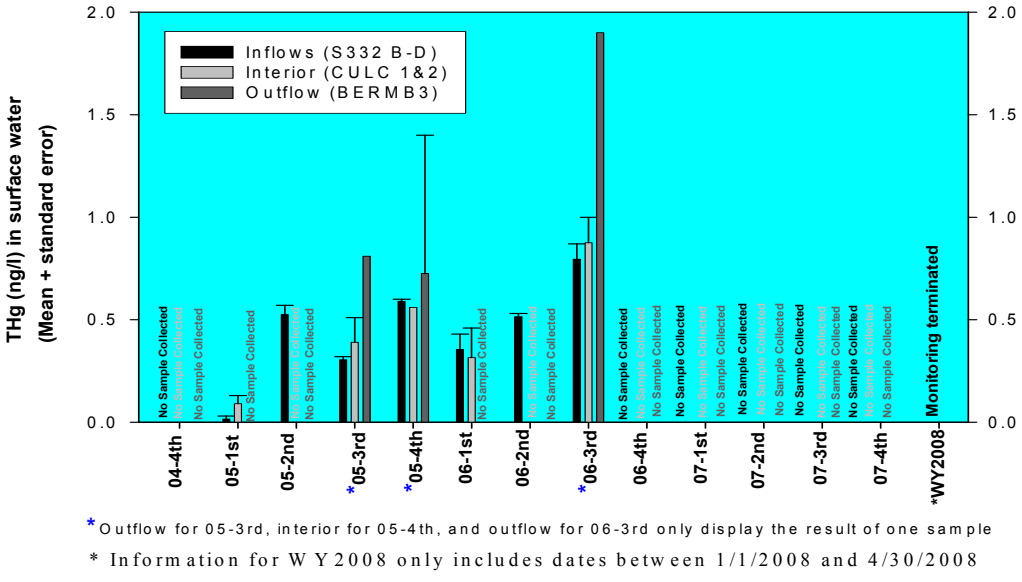
Mercury Monitoring at the C-111D Project

As a result of an approved mandate modification on August 2006, surface water sampling was terminated under project C-111D; therefore, no surface samples are reported for WY2008. Under the same approved mandate, largemouth bass and sunfish were eliminated from the C111D project and mosquitofish monitoring was reduced to annual collection. **Figures 17** and **18** provide the latest information for C-111D/F. The next mosquitofish collection is scheduled for October 2008. Refer to past reports for previous information on project C-111D/F.

Due to low water levels, the 2006 interior mosquitofish collection site CULC1 was replaced with CULC2 in 2007 and outflow site BERM B3 was replaced by diversion sites DS4 and DS2. In 2007, the median mosquitofish concentration for site CULC2 was 0.018 mg/kg. For DS4 and DS2 the median mosquitofish concentration was 0.01 mg/kg.

In WY2008, mosquitofish levels were well below the Southern Everglades 75th percentile concentration of 0.91 mg/kg (for the period of record up 2006) and the USFWS predator protection criteria of 0.1 mg/kg, therefore demonstrating no threat to piscivorous avian and mammalian wildlife. Except for the interior site (CUCLI) there is a visible temporal decrease in mosquitofish concentrations for the period of record. Mercury levels in all fish species are below average levels found in fish from all STAs and downstream Everglades monitoring locations (see 2008 SFER – Volume I).

During the course of the entire project total mercury (THg) surface water levels were well below the 12 ng/L Florida Class III numerical water quality standard.



Surface water samples were not collected when total depth was less than 20 cm.

Figure 17. Monitoring results for water-column THg for the C-111 Canal Project.

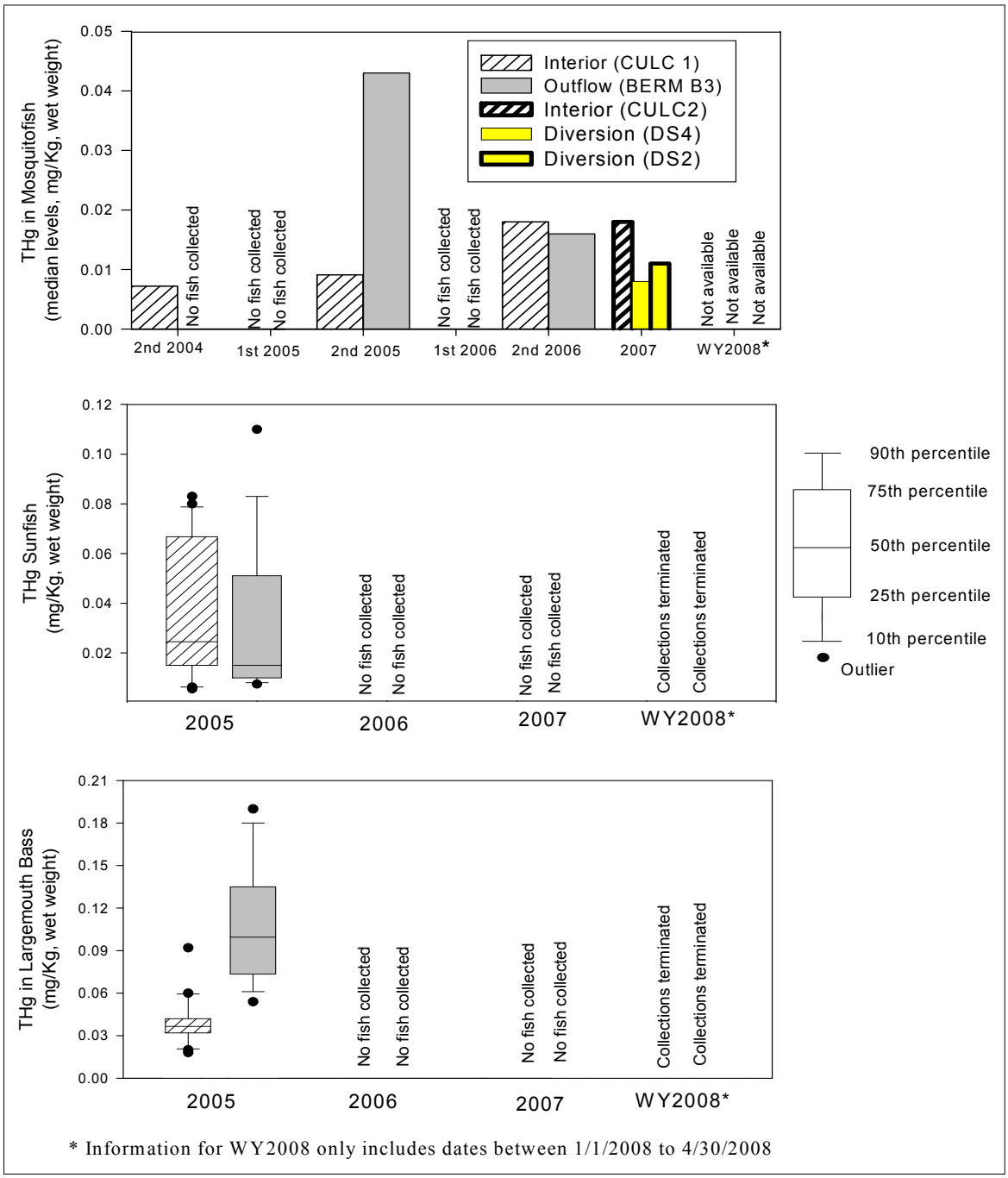


Figure 18. Results of Hg for mosquitofish (*top*), sunfish (*middle*), and largemouth bass (*bottom*).

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Attachment A: Interim Operation Plan Water Quality Sampling Sites, Monitoring Schedule, Flow Volumes and Flow-Weighted Mean Concentrations for Water Year 2008

Shi Kui Xue

Table A-1. Water quality monitoring schedule 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 Water
Inflow	S332 B	S332 B	BW	BW,WF (autosampler)	QTR	QTR	QTR			QTR
	S332C	S332C	BW		QTR	QTR	QTR			QTR
	S332D	S332D, S332DAS and S332DX	BW		QTR	QTR	QTR			QTR
Interior	C1	CULC1	Monthly	Monthly	Monthly		QTR			
	C2	CULC2	Monthly	Monthly	Monthly		QTR			
Outflow	BERMB3	BERMB3	BW	BW,WF (autosampler)	QTR	QTR	QTR			QTR
Diversion	DS1	DS1	Event	Event	Event		Event			Event
	DS2	DS2	Event	Event	Event		Event			Event
	DS3	DS3	Event	Event	Event		Event			Event
	DS4	DS4	Event	Event	Event		Event			Event
Cell	1								Annually	
	2								Annually	
	3								Annually	
	4								Annually	
	5								Annually	
	Flow Way								Annually	
Groundwater	S332B	S332BES	QTR	QTR	QTR	QTR				SA
		S332BED	QTR	QTR	QTR	QTR				SA
		S332BWS	QTR	QTR	QTR	QTR				SA
		S332BWD	QTR	QTR	QTR	QTR				SA
	S332C	S332CES	QTR	QTR	QTR	QTR				SA
		S332CED	QTR	QTR	QTR	QTR				SA
		S332CWS	QTR	QTR	QTR	QTR				SA
		S332CWD	QTR	QTR	QTR	QTR				SA
	S332D	S332DES	QTR	QTR	QTR	QTR				SA
		S332DED	QTR	QTR	QTR	QTR				SA
		S332DWS	QTR	QTR	QTR	QTR				SA
		S332DWD	QTR	QTR	QTR	QTR				SA

Table Legend:
BW =Biweekly
WF=Weekly if flowing
QTR =Quarterly
SA =Semiannually

Table A-2. Flow volume and flow-weighted mean total phosphorus concentrations for IOP for Protection of the CSSS structures during Water Year 2008 (WY2008) (May 1, 2007 through April 30, 2008).

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	FLOW		Quarter				Total Flow Volume (acre-ft)	Average TP Concentration (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	PK929 & SM556	13,432	11,959	578	530	26,499	8	6	5	23	138	92	4	15	248
	S332C	S332C	S332C	UT724	22,674	21,103	5,372	7	49,156	7	7	6	26	209	184	40	0	433
	S332D	S332D	S332D	TA413	9,219	18,231	4,446	794	32,689	8	6	6	12	91	126	33	11	262
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	32	NPF	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a [2]	n/a	n/a	n/a	n/a	n/a	26,499	7	6	6	5	n/a	n/a	n/a	n/a	126
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		6	6	6	6	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		6	8	7	4	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		5	5	6	5	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	49,156	111	82	82	90	n/a	n/a	n/a	n/a	1,162
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		9	8	9	9	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		4	21	6	6	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		8	7	8	7	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	32,689	4	6	6	5	n/a	n/a	n/a	n/a	159
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		6	6	7	6	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		6	11	7	5	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		5	5	6	5	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 A-3. Flow volume and flow-weighted mean total nitrogen concentrations for IOP for Protection of the CSSS structures during WY2008.

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	FLOW		Quarter				Total Flow Volume (acre-ft)	Average TN Concentration (ppm) 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	PK929 & SM556	13,432	11,959	578	530	26,499	1.028	0.712	0.716	1.619	17046	10515	511	1059	29,130
	S332C	S332C	S332C	UT724	22,674	21,103	5,372	7	49,156	-	-	0.671	1.376	19049	17146	4448	11	40,655
	S332D	S332D	S332D	TA413	9,219	18,231	4,446	794	32,689	0.708	0.627	0.616	1.427	8055	14122	3379	1398	26,954
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	NPF	0.610	NPF	NPF	NPF	NPF	NPF	NPF
Groundwater	S332B	S332BED	n/a	n/a	n/a	n/a	n/a	n/a	26,499	0.665	0.625	0.613	0.650	n/a	n/a	n/a	n/a	14,739
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		0.665	0.615	0.603	0.565	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		0.756	0.725	0.785	0.745	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		0.816	0.666	0.675	0.818	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	49,156	0.085	0.100	0.115	0.085	n/a	n/a	n/a	n/a	20,034
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		0.607	0.560	0.555	0.765	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		0.667	0.677	0.646	0.617	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		0.751	0.600	0.532	0.689	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	32,689	0.600	0.600	0.574	0.530	n/a	n/a	n/a	n/a	15,486
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		0.668	0.550	0.592	0.600	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		0.635	0.820	0.580	0.555	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		0.585	0.374	0.555	0.540	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 B: Time-Series and Box Plots for Water Quality Monitoring Data Exhibiting Excursions from Class III Numeric Standards for Water Year 2008

Shi Kui Xue and Steven Hill

The graphs in this appendix correspond to the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) water quality monitoring sites exhibiting excursions during Water Year 2008 (WY2008) (May 1, 2007 through April 30, 2008), as shown in **Table 3**. The graph sequencing follows the station and parameter order shown in that table. The C-111 Canal Project's EO #9 structure locations are depicted in **Figure 1**. 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.

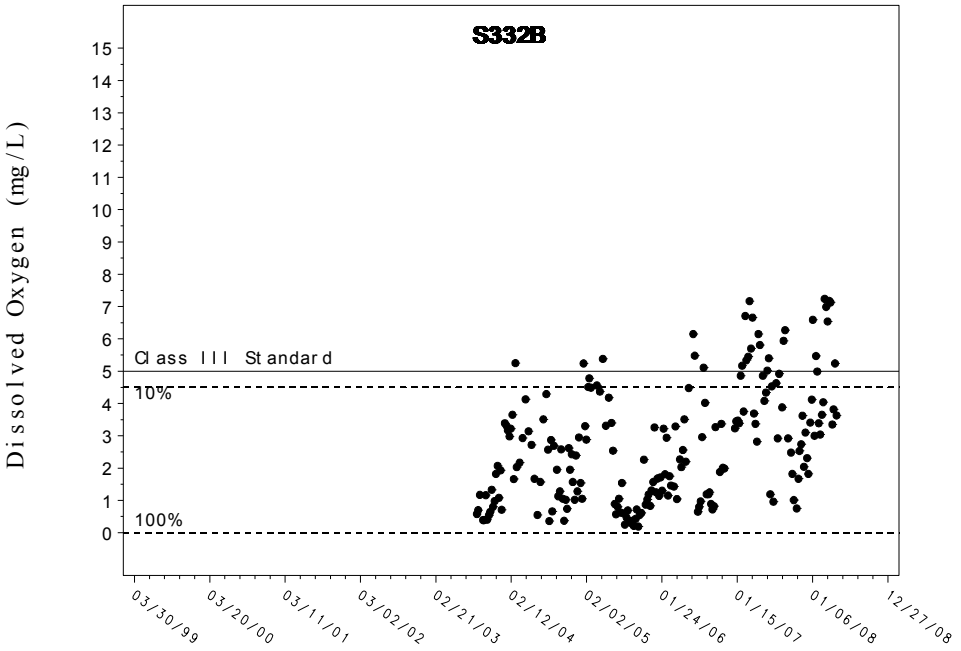

Figure B-1. Dissolved oxygen (DO) excursion at S-332B.

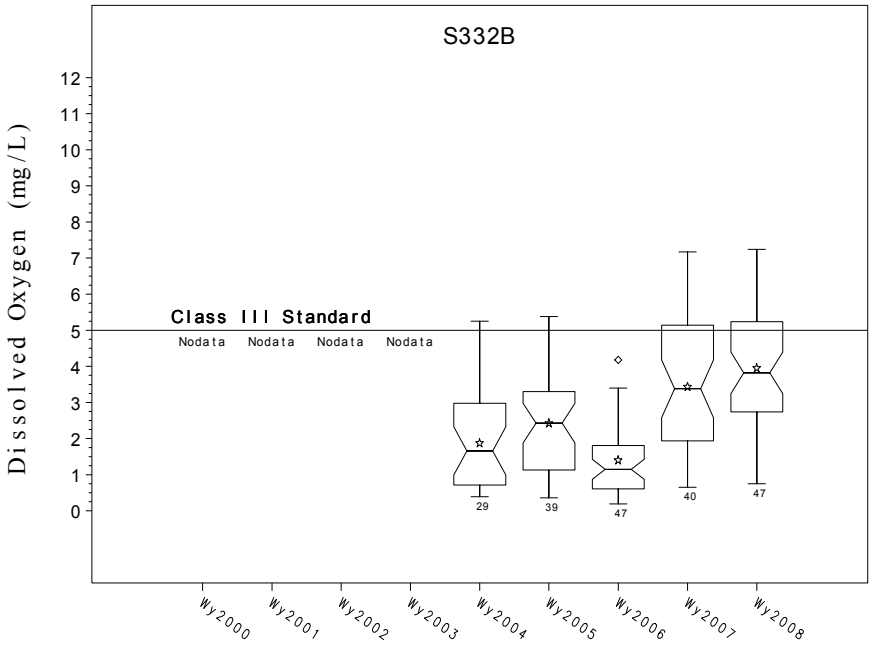

Figure B-2. DO notched box-and-whisker plot at S-332B.

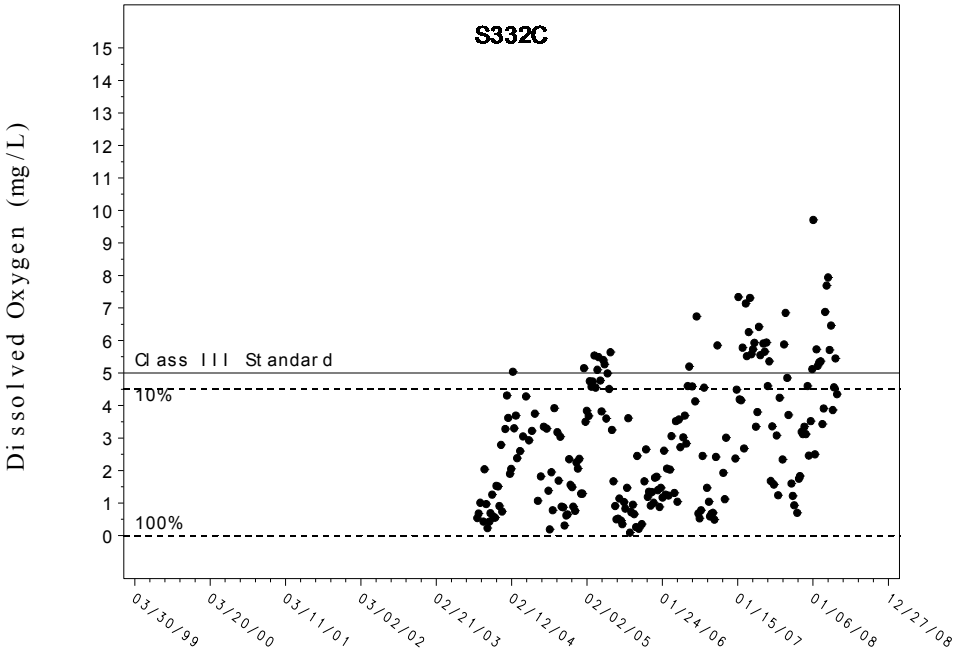

Figure B-3. DO excursion at S-332C.

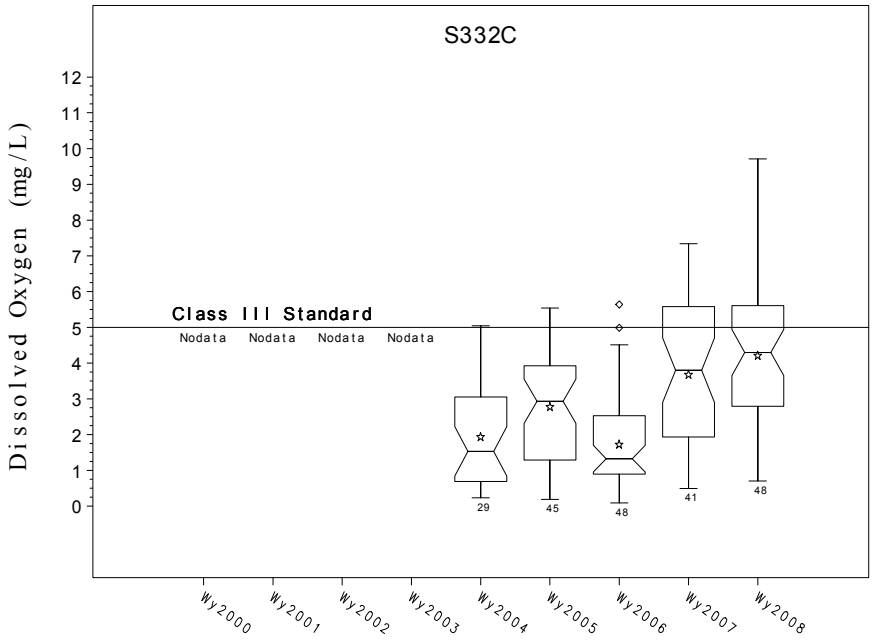

Figure B-4. DO notched box-and-whisker plot at S-332C.

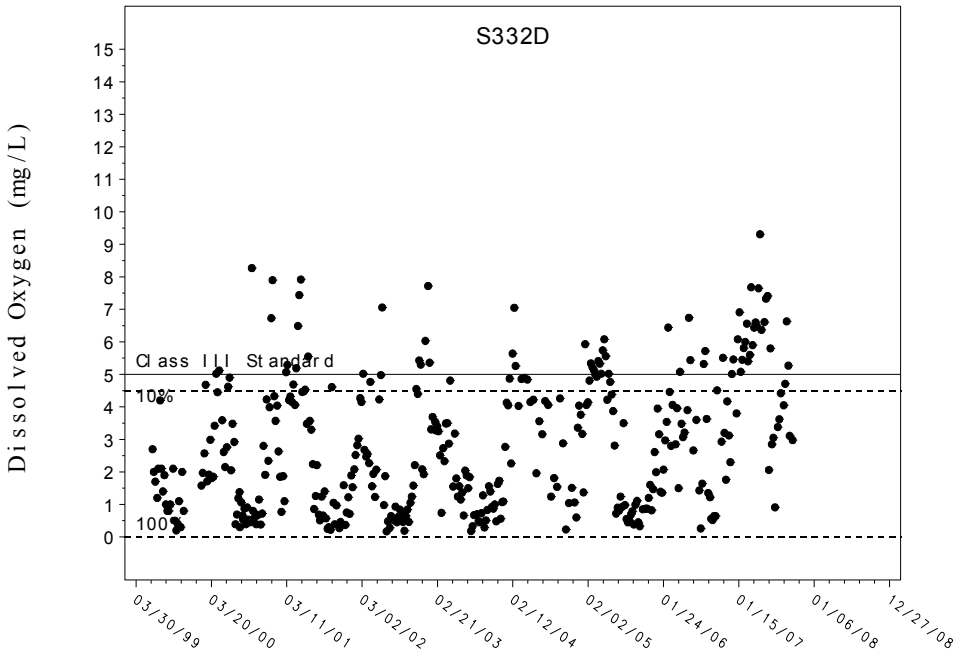

Figure B-5. DO excursion at S-332D.

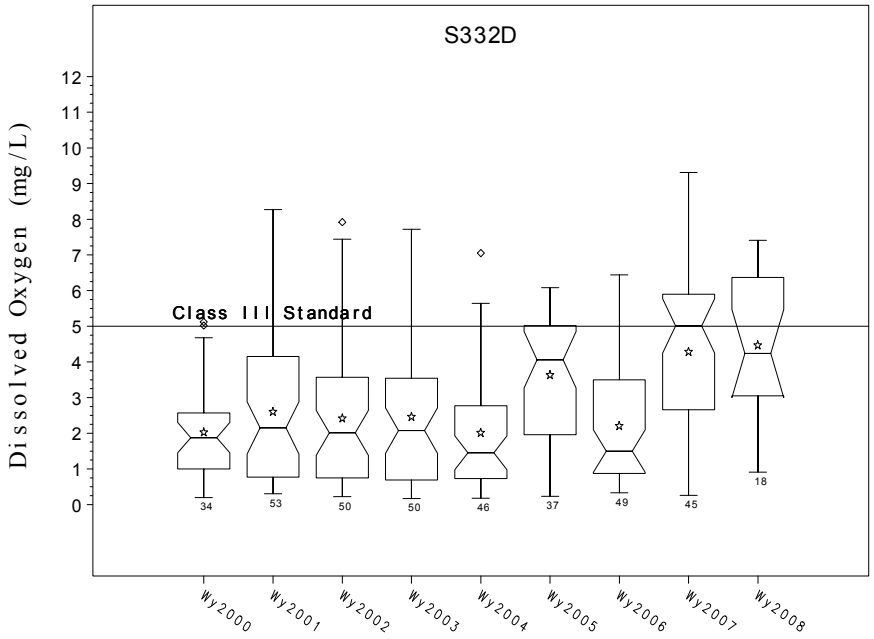

Figure B-6. DO notched box-and-whisker plot at S-332D.

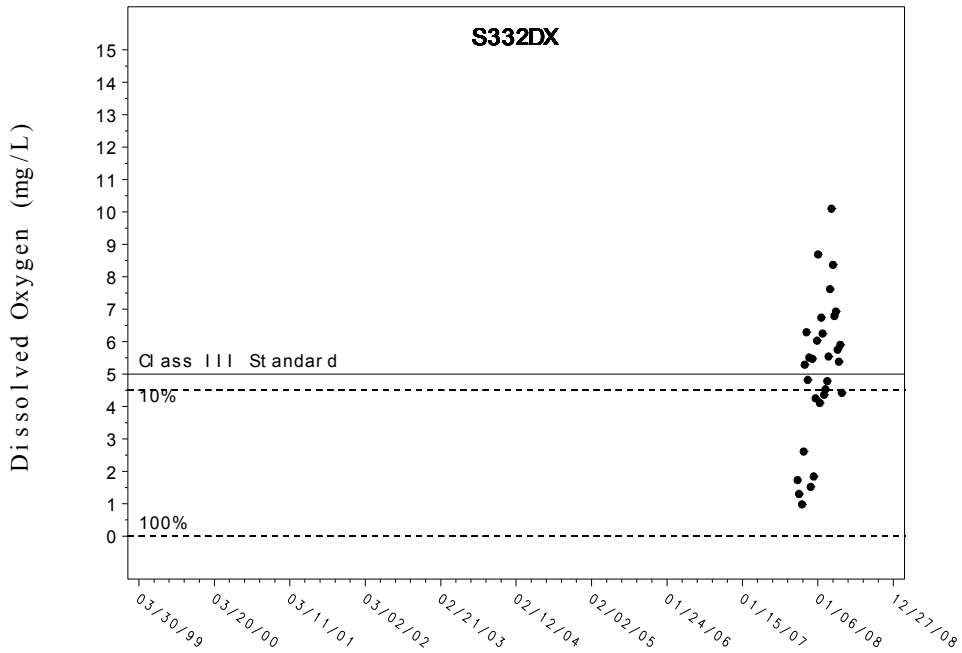

Figure B-7. DO excursion at S-332DX.

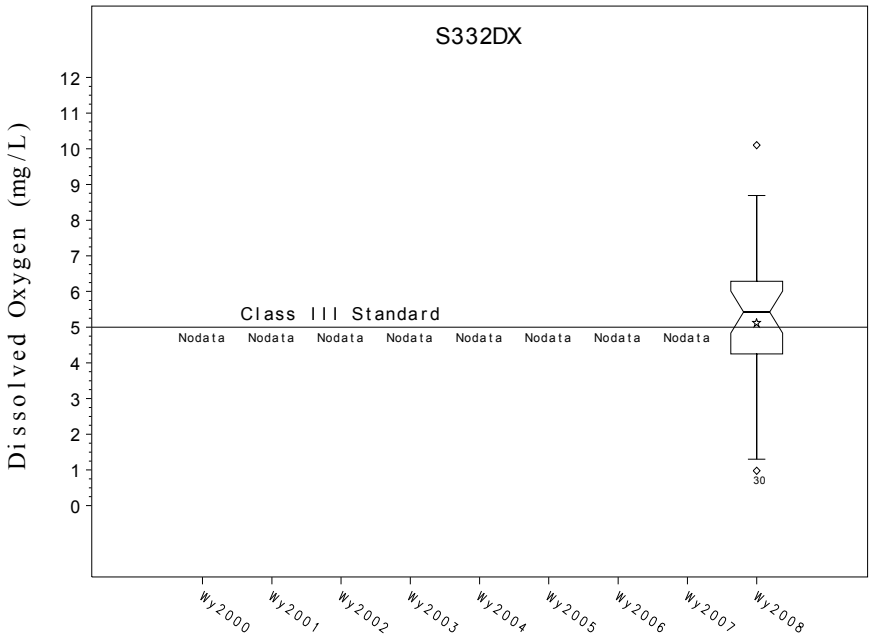

Figure B-8. DO notched box-and-whisker plot at S-332DX.

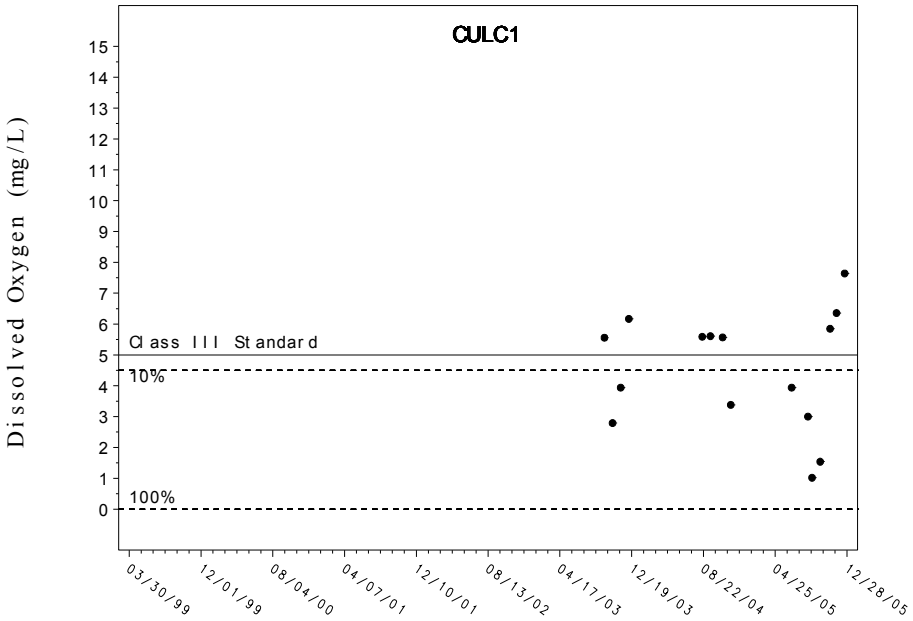

Figure B-9. DO excursion at CULC1.

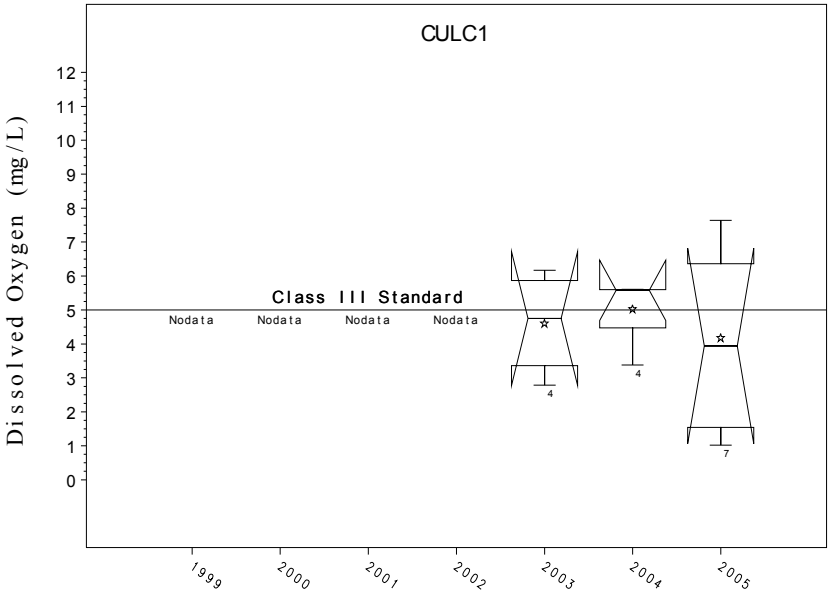

Figure B-10. DO notched box-and-whisker plot at CULC1.

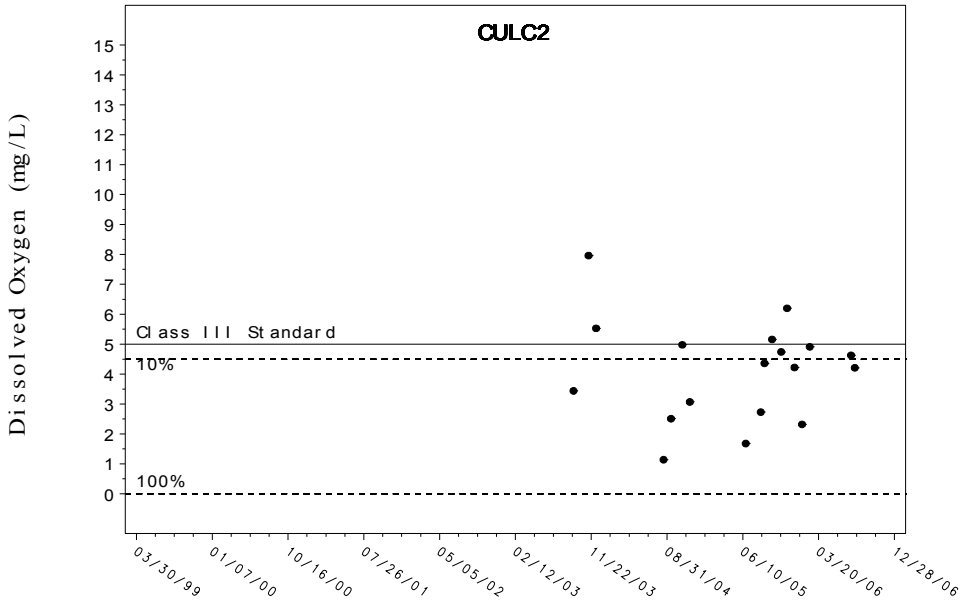

Figure B-11. DO excursion at CULC2.

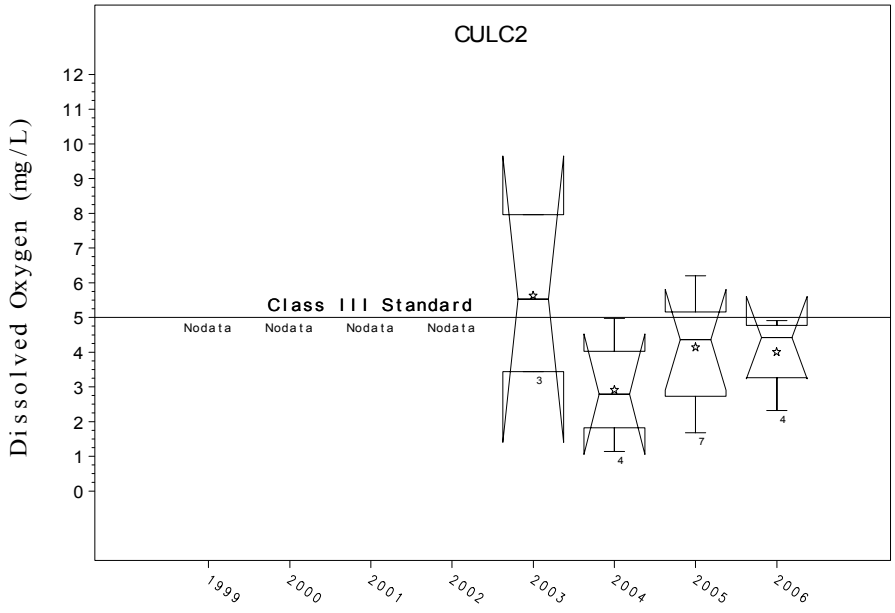

Figure B-12. DO notched box-and-whisker plot at CULC2.

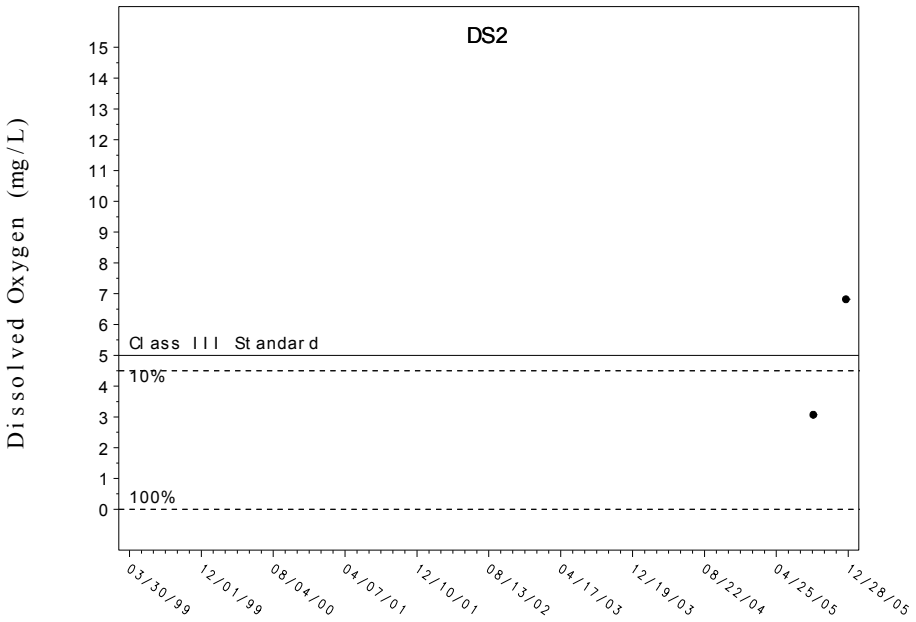

Figure B-13. DO excursion at DS2.

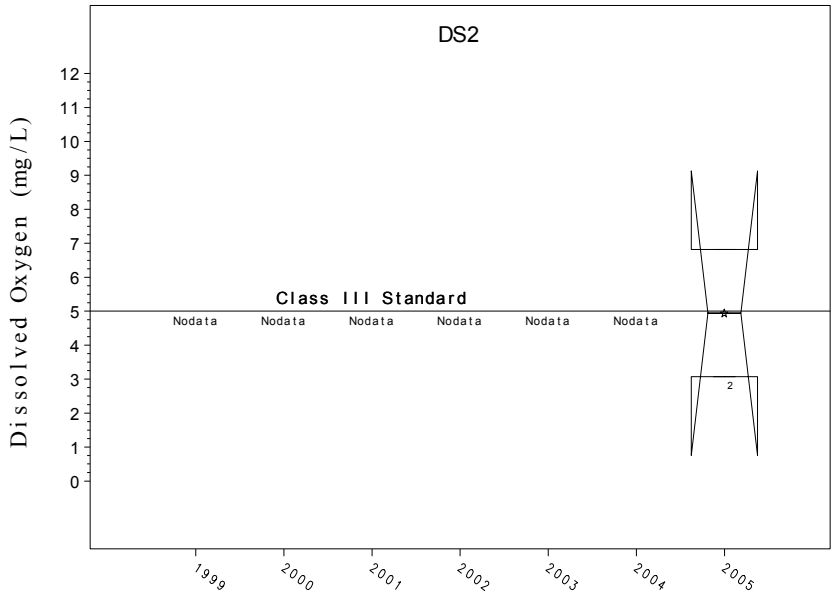

Figure B-14. DO notched box-and-whisker plot at DS2.

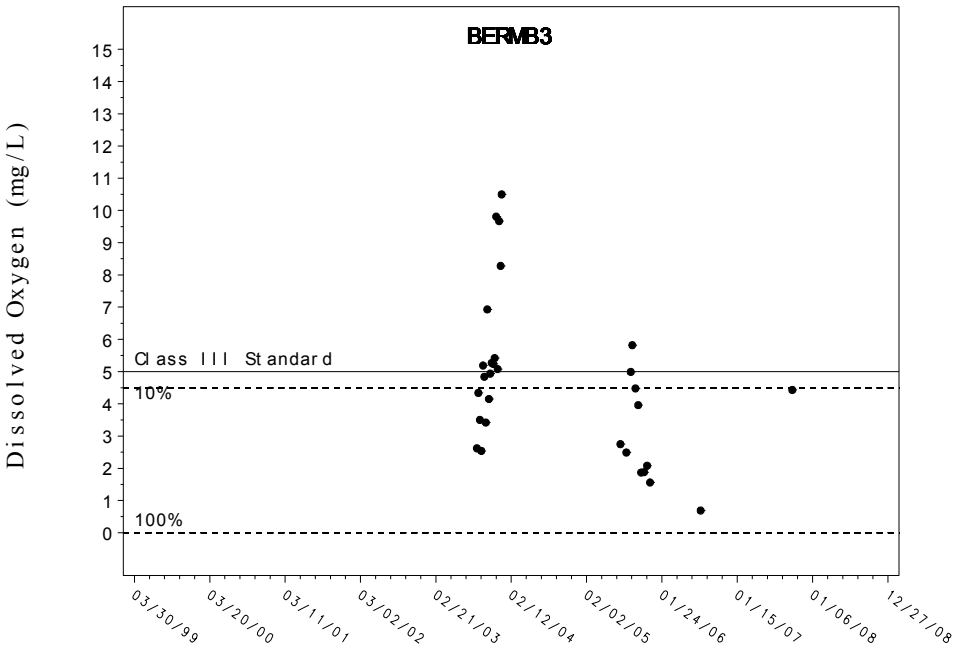

Figure B-15. DO excursion at BERMB3.

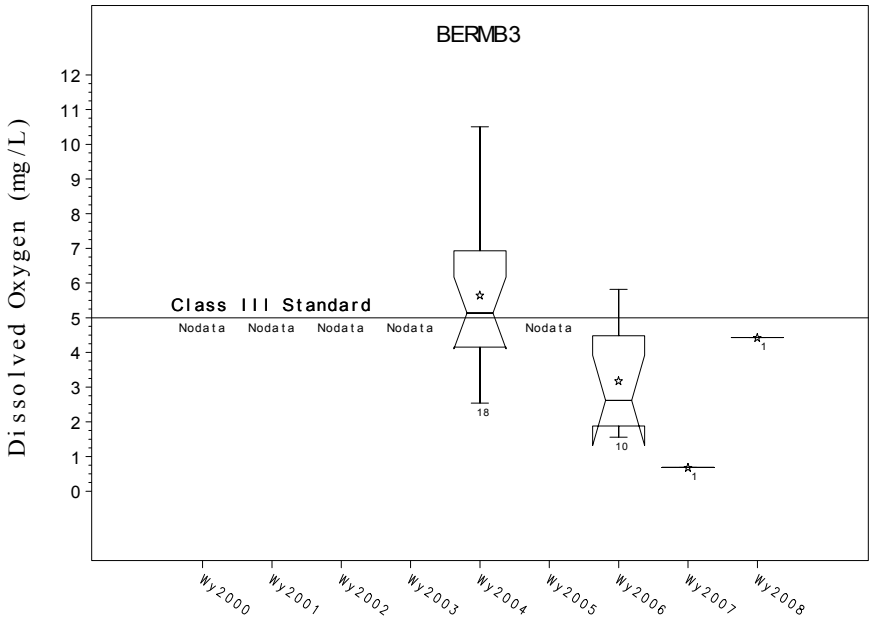

Figure B-16. DO notched box-and-whisker plot at BERMB3.

Attachment C: Summary Statistics of C-111 Water Quality Monitoring Data for Water Year 2008

Shi Kui Xue and Steven Hill

Summary statistics are tabulated in **Table 3** of this appendix for all parameters collected during Water Year 2008 (WY2008) (May 1, 2007 through April 30, 2008), at the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) water quality monitoring sites. **Table 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 3** are sequenced according to the order shown in **Table 1**. The monitoring sites are sequenced in the order shown in **Table 2**. The C-111 EO #9 structure locations are depicted in **Figure 1**.

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

Parameter Name	Abbreviated Parameter 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	Not less than 5.0 mg/L
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	$e^{(0.7852[\ln(\text{Hardness})-3.49])}$ µg/L
Total Copper	TOT. CU	µg/L	104	Less than or equal to calculated value using: $e^{(0.8545[\ln(\text{Hardness})-1.702])}$ 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: $e^{(0.8473[\ln(\text{Hardness})+0.884])}$ µg/L
Total Iron	TOT. FE	mg/L	177	Less than or equal to 1.0 mg/L

Table C-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	Comments
Inflow	S332B	S332B	Weekly time composite autosampler 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	Weekly time composite autosampler 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. A new water quality station id S332DX was used since 10/2/2007 for both auto and grab sample.
	S332D	S332D, S332DAS and S332DX	Autosampler 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.
Interior	C1	CULC1	No sample during the first quarter
	C2	CULC2	No sample during the first quarter
Diversion	DS1	DS1	No sample during the first quarter
	DS2	DS2	No sample during the first quarter
	DS3	DS3	No sample during the first quarter
	DS4	DS4	No sample during the first quarter
Outflow	BERMB3	BERMB3	Autosampler was installed in 2003, and has not been activated because of no flow
Groundwater	S332B	S332BES	S-332B East Shallow
		S332BED	S-332 B East Deep
		S332BWS	S-332B West Shallow
		S332BWD	S-332B West Deep
	S332C	S332CES	S-332C East Shallow
		S332CED	S-332 C East Deep
		S332CWS	S-332C West Shallow
		S332CWD	S-332C West Deep
	S332D	S332DES	S-332D East Shallow
		S332DED	S-332D East Deep
		S332DWS	S-332D West Shallow
		S332DWD	S-332D West Deep

Notes: Water quality sample site is located on upstream side of the structure unless otherwise noted with different representative sampling location.

Table C-3. Summary statistics of IOP for Protection of the CSSS water quality monitoring data (physical parameters, nutrients, major ions and trace metals) collected during Water Year 2008 (WY2008) (May 1, 2007 through April 30, 2008).

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	DIS. CA	mg/L	30	02OCT2007 - 02OCT2007	1	31.200		31.200	31.200	31.200	31.200	31.200	0	0	0.00%
BERMB3	DIS. K	mg/L	29	02OCT2007 - 02OCT2007	1	2.000		2.000	2.000	2.000	2.000	2.000	0	0	0.00%
BERMB3	DIS. MG	mg/L	31	02OCT2007 - 02OCT2007	1	1.200		1.200	1.200	1.200	1.200	1.200	0	0	0.00%
BERMB3	DIS. NA	mg/L	28	02OCT2007 - 02OCT2007	1	1.500		1.500	1.500	1.500	1.500	1.500	0	0	0.00%
BERMB3	DO	mg/L	8	02OCT2007 - 02OCT2007	1	4.430		4.430	4.430	4.430	4.430	4.430	0	1	100.00%
BERMB3	FLDCOND.	UMHOS/CM	9	02OCT2007 - 02OCT2007	1	167.000		167.000	167.000	167.000	167.000	167.000	0	0	0.00%
BERMB3	HARDNESS	mg/L CACO3	35	02OCT2007 - 02OCT2007	1	83.000		83.000	83.000	83.000	83.000	83.000	0	0	0.00%
BERMB3	OPO4	mg P/L	23	02OCT2007 - 02OCT2007	1	0.003		0.003	0.003	0.003	0.003	0.003	0	0	0.00%
BERMB3	PH	UNITS	10	02OCT2007 - 02OCT2007	1	7.200		7.200	7.200	7.200	7.200	7.200	0	0	0.00%
BERMB3	TEMP	CENT	7	02OCT2007 - 02OCT2007	1	25.000		25.000	25.000	25.000	25.000	25.000	0	0	0.00%
BERMB3	TKN	mg N/L	21	02OCT2007 - 02OCT2007	1	0.610		0.610	0.610	0.610	0.610	0.610	0	0	0.00%
BERMB3	TN	mg N/L	80	02OCT2007 - 02OCT2007	1	0.610		0.610	0.610	0.610	0.610	0.610	0	0	0.00%
BERMB3	TOT. CL	mg/L	32	02OCT2007 - 02OCT2007	1	2.300		2.300	2.300	2.300	2.300	2.300	0	0	0.00%
BERMB3	TOT. SO4	mg/L	33	02OCT2007 - 02OCT2007	1	0.200		0.200	0.200	0.200	0.200	0.200	0	0	0.00%
BERMB3	TP	mg P/L	25	02OCT2007 - 02OCT2007	1	0.032		0.032	0.032	0.032	0.032	0.032	0	0	0.00%
BERMB3	TSS	mg/L	16	02OCT2007 - 02OCT2007	1	3.000		<3	<3	<3	<3	<3	1	0	0.00%
BERMB3	TURBIDITY	NTU	12	02OCT2007 - 02OCT2007	1	2.100		2.100	2.100	2.100	2.100	2.100	0	0	0.00%
S332B	DIS. CA	mg/L	30	13JUN2007 - 08APR2008	15	81.360	3.816	71.700	79.400	81.900	83.700	87.100	0	0	0.00%
S332B	DIS. K	mg/L	29	13JUN2007 - 08APR2008	15	3.113	0.650	2.300	2.800	3.000	3.300	5.100	0	0	0.00%
S332B	DIS. MG	mg/L	31	13JUN2007 - 08APR2008	15	7.233	3.187	5.200	6.000	6.300	6.600	18.200	0	0	0.00%
S332B	DIS. NA	mg/L	28	13JUN2007 - 08APR2008	15	27.107	11.253	21.600	23.000	23.900	24.600	66.700	0	0	0.00%
S332B	DIS. ORGAN. C	mg/L	89;181	11JUL2007 - 11JUL2007	1	8.600		8.600	8.600	8.600	8.600	8.600	0	0	0.00%
S332B	DO	mg/L	8	02MAY2007 - 28APR2008	47	3.966	1.780	0.750	2.740	3.820	5.240	7.240	0	34	72.34%
S332B	FLDCOND.	UMHOS/CM	9	02MAY2007 - 28APR2008	51	609.941	100.353	510.000	543.000	549.000	706.000	857.000	0	0	0.00%
S332B	HARDNESS	mg/L CACO3	35	13JUN2007 - 08APR2008	15	232.880	10.855	221.600	224.200	231.100	237.000	256.900	0	0	0.00%
S332B	NO2	mg N/L	19	20JUN2007 - 26SEP2007	5	0.003	0.001	<0.002	0.002	0.003	0.004	0.005	1	0	0.00%
S332B	NO3	mg N/L	78	20JUN2007 - 26SEP2007	4	0.064	0.050	0.023	0.029	0.049	0.098	0.134	0	0	0.00%
S332B	NOX	mg N/L	18;180	02MAY2007 - 08APR2008	16	0.054	0.029	0.020	0.035	0.051	0.065	0.139	0	0	0.00%
S332B	OPO4	mg P/L	23	20JUN2007 - 08APR2008	14	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.002	12	0	0.00%
S332B	PH	UNITS	10	02MAY2007 - 28APR2008	51	7.320	0.176	6.900	7.200	7.300	7.400	7.800	0	0	0.00%
S332B	TEMP	CENT	7	02MAY2007 - 28APR2008	52	25.450	2.055	20.300	24.100	25.400	26.600	29.400	0	0	0.00%
S332B	TKN	mg N/L	21	02MAY2007 - 08APR2008	23	0.701	0.217	0.510	0.570	0.640	0.690	1.340	0	0	0.00%
S332B	TN	mg N/L	80	02MAY2007 - 08APR2008	23	0.738	0.222	0.510	0.640	0.672	0.744	1.406	0	0	0.00%
S332B	TOT. CL	mg/L	32	13JUN2007 - 08APR2008	15	41.267	17.143	33.200	35.100	36.700	37.100	102.000	0	0	0.00%
S332B	TOT. SO4	mg/L	33	11JUL2007 - 08AUG2007	2	1.750	0.778	1.200	1.200	1.750	2.300	2.300	0	0	0.00%
S332B	TP	mg P/L	25	02MAY2007 - 28APR2008	53	0.007	0.002	0.005	0.006	0.006	0.008	0.013	0	0	0.00%
S332B	TSS	mg/L	16	02OCT2007 - 08APR2008	6	3.000	0.000	<3	<3	<3	<3	<3	6	0	0.00%
S332B	TURBIDITY	NTU	12	13JUN2007 - 26SEP2007	9	2.822	0.800	1.100	2.700	2.800	3.000	4.000	0	0	0.00%
S332BAuto	NOX	mg N/L	18;180	13JUN2007 - 14APR2008	19	0.046	0.027	0.019	0.027	0.038	0.066	0.120	0	0	0.00%
S332BAuto	TKN	mg N/L	21	13JUN2007 - 14APR2008	21	0.906	0.518	0.520	0.640	0.660	1.020	2.670	0	0	0.00%
S332BAuto	TN	mg N/L	80	13JUN2007 - 14APR2008	21	0.947	0.535	0.543	0.660	0.711	1.047	2.737	0	0	0.00%
S332BAuto	TP	mg P/L	25	13JUN2007 - 14APR2008	21	0.010	0.008	0.005	0.006	0.007	0.008	0.037	0	0	0.00%
S332C	DIS. CA	mg/L	30	13JUN2007 - 08APR2008	22	74.668	17.029	<0.2	76.000	77.150	80.200	87.400	1	0	0.00%
S332C	DIS. K	mg/L	29	13JUN2007 - 08APR2008	22	2.600	0.819	<0.1	2.400	2.600	2.700	5.200	1	0	0.00%
S332C	DIS. MG	mg/L	31	13JUN2007 - 08APR2008	22	6.945	3.107	<0.1	6.100	6.400	6.700	18.500	1	0	0.00%
S332C	DIS. NA	mg/L	28	13JUN2007 - 08APR2008	22	26.255	11.015	<0.2	24.000	25.050	25.700	68.100	1	0	0.00%
S332C	DIS. ORGAN. C	mg/L	89;181	11JUL2007 - 11JUL2007	1	7.700		7.700	7.700	7.700	7.700	7.700	0	0	0.00%
S332C	DO	mg/L	8	02MAY2007 - 28APR2008	48	4.217	2.014	0.700	2.790	4.295	5.605	9.710	0	29	60.42%
S332C	FLDCOND.	UMHOS/CM	9	02MAY2007 - 28APR2008	52	606.212	103.821	526.000	536.000	544.000	684.000	859.000	0	0	0.00%
S332C	HARDNESS	mg/L CACO3	35	13JUN2007 - 08APR2008	22	215.105	49.786	<1	216.000	219.500	226.800	258.000	1	0	0.00%
S332C	NH4	mg N/L	20	26SEP2007 - 26SEP2007	1	0.005		0.005	0.005	0.005	0.005	0.005	0	0	0.00%
S332C	NNH4	mg N/L	92	26SEP2007 - 26SEP2007	1	0.015		0.015	0.015	0.015	0.015	0.015	0	0	0.00%

Table C-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	NO2	mg N/L	19	13JUN2007 - 26SEP2007	9	0.002	0.001	<0.002	<0.002	<0.002	0.002	0.006	6	0	0.00%
S332C	NO3	mg N/L	78	13JUN2007 - 26SEP2007	6	0.026	0.016	0.010	0.016	0.020	0.033	0.054	0	0	0.00%
S332C	NOX	mg N/L	18;180	02MAY2007 - 08APR2008	17	0.042	0.033	0.010	0.025	0.031	0.060	0.143	0	0	0.00%
S332C	OPO4	mg P/L	23	13JUN2007 - 08APR2008	22	0.002	0.000	<0.002	<0.002	<0.002	0.002	0.002	15	0	0.00%
S332C	ORGN	mg N/L	79	26SEP2007 - 26SEP2007	1	0.050		<0.05	<0.05	<0.05	<0.05	<0.05	1	0	0.00%
S332C	PH	UNITS	10	02MAY2007 - 28APR2008	52	7.350	0.218	7.000	7.200	7.400	7.500	7.800	0	0	0.00%
S332C	TEMP	CENT	7	02MAY2007 - 28APR2008	53	25.538	1.996	20.400	24.400	25.800	26.700	30.300	0	0	0.00%
S332C	TKN	mg N/L	21	02MAY2007 - 08APR2008	29	0.687	0.259	<0.05	0.580	0.620	0.660	1.370	1	0	0.00%
S332C	TN	mg N/L	80	02MAY2007 - 08APR2008	29	0.727	0.243	<0.5	0.597	0.640	0.685	1.434	1	0	0.00%
S332C	TOT. CL	mg/L	32	13JUN2007 - 08APR2008	22	39.573	16.788	<0.1	36.500	37.850	38.800	104.000	1	0	0.00%
S332C	TOT. SO4	mg/L	33	11JUL2007 - 08AUG2007	2	1.150	0.071	1.100	1.100	1.150	1.200	1.200	0	0	0.00%
S332C	TP	mg P/L	25	02MAY2007 - 28APR2008	53	0.006	0.002	0.002	0.005	0.006	0.007	0.011	0	0	0.00%
S332C	TSS	mg/L	16	02OCT2007 - 08APR2008	11	3.000	0.000	<3	<3	<3	<3	<3	11	0	0.00%
S332C	TURBIDITY	NTU	12	13JUN2007 - 26SEP2007	11	2.164	1.095	<0.1	1.300	2.200	3.000	4.100	1	0	0.00%
S332CAuto	NOX	mg N/L	18;180	20JUN2007 - 28APR2008	22	0.037	0.026	0.008	0.023	0.035	0.042	0.125	0	0	0.00%
S332CAuto	TKN	mg N/L	21	20JUN2007 - 28APR2008	23	0.777	0.288	0.530	0.600	0.640	0.770	1.420	0	0	0.00%
S332CAuto	TN	mg N/L	80	20JUN2007 - 28APR2008	23	0.812	0.308	0.554	0.624	0.665	0.815	1.545	0	0	0.00%
S332CAuto	TP	mg P/L	25	20JUN2007 - 28APR2008	22	0.009	0.009	0.004	0.006	0.007	0.008	0.043	0	0	0.00%
S332D	ALKALINITY	mg/L	67	11JUL2007 - 08AUG2007	2	216.500	2.121	215.000	215.000	216.500	218.000	218.000	0	0	0.00%
S332D	DIS. CA	mg/L	30	11JUL2007 - 08AUG2007	2	77.900	1.131	77.100	77.100	77.900	78.700	78.700	0	0	0.00%
S332D	DIS. K	mg/L	29	11JUL2007 - 08AUG2007	2	2.650	0.071	2.600	2.600	2.650	2.700	2.700	0	0	0.00%
S332D	DIS. MG	mg/L	31	11JUL2007 - 08AUG2007	2	6.600	0.141	6.500	6.500	6.600	6.700	6.700	0	0	0.00%
S332D	DIS. NA	mg/L	28	11JUL2007 - 08AUG2007	2	25.500	0.424	25.200	25.200	25.500	25.800	25.800	0	0	0.00%
S332D	DIS. ORGAN. C	mg/L	89;181	11JUL2007 - 08AUG2007	2	7.700	0.141	7.600	7.600	7.700	7.800	7.800	0	0	0.00%
S332D	DIS. SILICA	mg/L	27	11JUL2007 - 08AUG2007	2	6.445	0.078	6.390	6.390	6.445	6.500	6.500	0	0	0.00%
S332D	DO	mg/L	8	02MAY2007 - 26SEP2007	18	4.476	1.901	0.910	3.050	4.235	6.370	7.410	0	11	61.11%
S332D	FLDCOND.	UMHOS/CM	9	02MAY2007 - 26SEP2007	21	531.571	8.784	506.000	529.000	535.000	538.000	542.000	0	0	0.00%
S332D	HARDNESS	mg/L CACO3	35	11JUL2007 - 08AUG2007	2	221.750	3.323	219.400	219.400	221.750	224.100	224.100	0	0	0.00%
S332D	NH4	mg N/L	20	16MAY2007 - 06SEP2007	8	0.061	0.042	<0.005	0.027	0.056	0.102	0.115	1	0	0.00%
S332D	NNH4	mg N/L	92	16MAY2007 - 06SEP2007	6	0.078	0.060	0.003	0.052	0.055	0.136	0.164	0	0	0.00%
S332D	NO2	mg N/L	19	16MAY2007 - 06SEP2007	7	0.002	0.000	<0.002	<0.002	0.002	0.003	0.003	2	0	0.00%
S332D	NO3	mg N/L	78	16MAY2007 - 06SEP2007	5	0.017	0.012	<0.004	0.006	0.023	0.025	0.029	1	0	0.00%
S332D	NOX	mg N/L	18;180	16MAY2007 - 06SEP2007	6	0.023	0.016	0.003	0.008	0.026	0.029	0.049	0	0	0.00%
S332D	OPO4	mg P/L	23	16MAY2007 - 06SEP2007	7	0.002	0.000	<0.002	<0.002	<0.002	<0.002	0.003	6	0	0.00%
S332D	ORGN	mg N/L	79	16MAY2007 - 06SEP2007	8	0.535	0.089	0.460	0.481	0.519	0.538	0.743	0	0	0.00%
S332D	PH	UNITS	10	02MAY2007 - 26SEP2007	22	7.409	0.302	7.000	7.200	7.300	7.600	8.100	0	0	0.00%
S332D	TEMP	CENT	7	02MAY2007 - 26SEP2007	22	27.191	1.167	25.400	26.200	27.200	27.900	30.100	0	0	0.00%
S332D	TKN	mg N/L	21	16MAY2007 - 06SEP2007	8	0.595	0.077	0.540	0.550	0.565	0.610	0.770	0	0	0.00%
S332D	TN	mg N/L	80	16MAY2007 - 06SEP2007	8	0.613	0.088	0.540	0.561	0.578	0.643	0.799	0	0	0.00%
S332D	TOT. CL	mg/L	32	16MAY2007 - 06SEP2007	7	38.500	0.821	37.500	37.800	38.600	38.800	40.000	0	0	0.00%
S332D	TOT. FE	mg/L	177	11JUL2007 - 08AUG2007	2	0.359	0.062	0.315	0.315	0.359	0.403	0.403	0	0	0.00%
S332D	TOT. FIL RES.	mg/L	97	11JUL2007 - 08AUG2007	2	308.500	10.607	301.000	301.000	308.500	316.000	316.000	0	0	0.00%
S332D	TOT. MTHY HG	ug/L	203	17JUL2007 - 17JUL2007	1	0.000		0.000	0.000	0.000	0.000	0.000	0	0	0.00%
S332D	TOT. SO4	mg/L	33	11JUL2007 - 08AUG2007	2	1.000	0.141	0.900	0.900	1.000	1.100	1.100	0	0	0.00%
S332D	TOT. ULTRA TRACE HG	ug/L	207	17JUL2007 - 17JUL2007	1	0.002		0.002	0.002	0.002	0.002	0.002	0	0	0.00%
S332D	TP	mg P/L	25	02MAY2007 - 26SEP2007	21	0.006	0.001	0.004	0.005	0.006	0.006	0.009	0	0	0.00%
S332D	TSS	mg/L	16	16MAY2007 - 06SEP2007	7	3.000	0.000	<3	<3	<3	<3	<3	7	0	0.00%
S332D	TURBIDITY	NTU	12	16MAY2007 - 06SEP2007	7	1.929	0.419	1.300	1.400	2.000	2.200	2.400	0	0	0.00%
S332D	UN-IONIZED AMMONIA	mg/L	NONE	02MAY2007 - 26SEP2007	8	0.001	0.000	0.000	0.001	0.001	0.001	0.002	0	0	0.00%
S332DASAuto	NOX	mg N/L	18;180	13JUN2007 - 12SEP2007	11	0.018	0.009	0.005	0.010	0.020	0.028	0.031	0	0	0.00%
S332DASAuto	TKN	mg N/L	21	13JUN2007 - 12SEP2007	12	0.685	0.171	0.530	0.575	0.615	0.750	1.100	0	0	0.00%
S332DASAuto	TN	mg N/L	80	13JUN2007 - 12SEP2007	12	0.702	0.176	0.535	0.597	0.635	0.769	1.128	0	0	0.00%
S332DASAuto	TP	mg P/L	25	13JUN2007 - 12SEP2007	12	0.008	0.002	0.005	0.007	0.008	0.010	0.010	0	0	0.00%

Table C-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	DIS. CA	mg/L	30	02OCT2007 - 28APR2008	21	83.062	7.028	72.400	76.800	80.200	89.200	95.500	0	0	0.00%
S332DX	DIS. K	mg/L	29	02OCT2007 - 28APR2008	21	3.086	1.215	2.200	2.400	2.600	3.100	6.200	0	0	0.00%
S332DX	DIS. MG	mg/L	31	02OCT2007 - 28APR2008	21	10.557	4.568	5.800	6.300	10.200	12.600	20.900	0	0	0.00%
S332DX	DIS. NA	mg/L	28	02OCT2007 - 28APR2008	21	36.767	15.149	23.600	24.700	32.900	43.000	69.200	0	0	0.00%
S332DX	DIS. ORGAN. C	mg/L	89;181	02OCT2007 - 08APR2008	3	15.200	8.386	7.300	7.300	14.300	24.000	24.000	0	0	0.00%
S332DX	DO	mg/L	8	02OCT2007 - 28APR2008	30	5.130	2.234	0.980	4.250	5.425	6.290	10.100	0	13	43.33%
S332DX	FLDCOND.	UMHOS/CM	9	02OCT2007 - 28APR2008	31	644.000	119.093	504.000	535.000	612.000	741.000	873.000	0	0	0.00%
S332DX	HARDNESS	mg/L CACO3	35	02OCT2007 - 28APR2008	21	250.843	27.066	213.300	220.600	259.700	273.400	286.700	0	0	0.00%
S332DX	NOX	mg N/L	18;180	02OCT2007 - 28APR2008	17	0.104	0.074	0.018	0.054	0.100	0.127	0.332	0	0	0.00%
S332DX	OPO4	mg P/L	23	02OCT2007 - 28APR2008	18	0.002	0.001	<0.002	<0.002	<0.002	0.002	0.005	13	0	0.00%
S332DX	PH	UNITS	10	02OCT2007 - 28APR2008	30	7.487	0.229	7.000	7.400	7.500	7.600	7.800	0	0	0.00%
S332DX	TEMP	CENT	7	02OCT2007 - 28APR2008	31	24.494	1.750	20.700	23.500	24.500	25.600	29.500	0	0	0.00%
S332DX	TKN	mg N/L	21	02OCT2007 - 28APR2008	22	1.051	0.328	0.580	0.600	1.150	1.240	1.610	0	0	0.00%
S332DX	TN	mg N/L	80	02OCT2007 - 28APR2008	22	1.132	0.388	0.580	0.635	1.249	1.313	1.942	0	0	0.00%
S332DX	TOT. CL	mg/L	32	02OCT2007 - 28APR2008	21	53.010	21.935	26.400	36.800	47.800	64.000	108.000	0	0	0.00%
S332DX	TOT. MTHY HG	ug/L	203	23OCT2007 - 15APR2008	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.00%
S332DX	TOT. SO4	mg/L	33	02OCT2007 - 08APR2008	3	4.600	6.678	0.400	0.400	1.100	12.300	12.300	0	0	0.00%
S332DX	TOT. ULTRA TRACE HG	ug/L	207	23OCT2007 - 15APR2008	3	0.000	0.001	<0.0001	<0.0001	0.000	0.001	0.001	1	0	0.00%
S332DX	TP	mg P/L	25	02OCT2007 - 28APR2008	31	0.007	0.003	0.004	0.005	0.006	0.007	0.017	0	0	0.00%
S332DX	TSS	mg/L	16	02OCT2007 - 28APR2008	21	3.000	0.000	<3	<3	<3	<3	<3	21	0	0.00%
S332DX	TURBIDITY	NTU	12	02OCT2007 - 08APR2008	3	2.467	1.069	1.300	1.300	2.700	3.400	3.400	0	0	0.00%
S332DXAuto	NOX	mg N/L	18;180	02OCT2007 - 28APR2008	186	0.083	0.054	0.014	0.043	0.069	0.118	0.331	0	0	0.00%
S332DXAuto	TKN	mg N/L	21	02OCT2007 - 28APR2008	199	1.054	0.355	0.550	0.610	1.160	1.260	1.930	0	0	0.00%
S332DXAuto	TN	mg N/L	80	02OCT2007 - 28APR2008	199	1.132	0.397	0.580	0.641	1.234	1.398	2.053	0	0	0.00%
S332DXAuto	TP	mg P/L	25	02OCT2007 - 28APR2008	199	0.009	0.005	0.004	0.006	0.007	0.011	0.051	0	0	0.00%

Table C-4. WY2008 summary results of C-111 EO #9 total dissolved solids.

Type	EO #9 PERMIT STRUCTURE	WATER QUALITY SAMPLING SITE	FLOW		Quarter				Total Flow Volume (acre-ft)	Total Dissolved Solids (mg/L) by quarter				Total Dissolved Solids Load (metric ton) by quarter				Total Load (metric ton)
			STATION	DBKEY	1st	2nd	3rd	4th		1st	2nd	3rd	4th	1st	2nd	3rd	4th	
inflow	S332B	S332B	S332B	PK929 & SM556	13,432	11,959	578	530	26,499	M	M	M	M	n/a	n/a	n/a	n/a	n/a
	S332C	S332C	S332C	UT724	22,674	21,103	5,372	7	49,156	M	M	M	M	n/a	n/a	n/a	n/a	n/a
	S332D	S332D	S332D	TA413	9,219	18,231	4,446	794	32,689	M	M	309	M	n/a	n/a	1692	n/a	12,440
interior	C1	CULC1			M [5]	M		M	M	M	M	M	M	M	M	M	M	n/a
	C2	CULC2			M	M		M	M	M	M	M	M	M	M	M	M	n/a
Diversion	DS1	DS1	DS1		NPF [3]	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	n/a
	DS2	DS2	DS2		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	n/a
	DS3	DS3	DS3		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	n/a
	DS4	DS4	DS4		NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	n/a
Outflow	BERMB3	BERMB3	BERMB3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Groundwater	S332B	S332BED	n/a	n/a	n/a	n/a	n/a	n/a	26,499	327	315	318	306	n/a	n/a	n/a	n/a	10,420
		S332BES	n/a	n/a	n/a	n/a	n/a	n/a		336	321	322	323	n/a	n/a	n/a	n/a	
		S332BWD	n/a	n/a	n/a	n/a	n/a	n/a		340	298	328	311	n/a	n/a	n/a	n/a	
		S332BWS	n/a	n/a	n/a	n/a	n/a	n/a		346	282	311	316	n/a	n/a	n/a	n/a	
	S332C	S332CED	n/a	n/a	n/a	n/a	n/a	n/a	49,156	176	221	223	195	n/a	n/a	n/a	n/a	16,835
		S332CES	n/a	n/a	n/a	n/a	n/a	n/a		316	304	303	326	n/a	n/a	n/a	n/a	
		S332CWD	n/a	n/a	n/a	n/a	n/a	n/a		324	292	291	281	n/a	n/a	n/a	n/a	
		S332CWS	n/a	n/a	n/a	n/a	n/a	n/a		318	274	302	296	n/a	n/a	n/a	n/a	
	S332D	S332DED	n/a	n/a	n/a	n/a	n/a	n/a	32,689	281	287	278	272	n/a	n/a	n/a	n/a	11,352
		S332DES	n/a	n/a	n/a	n/a	n/a	n/a		281	278	275	270	n/a	n/a	n/a	n/a	
		S332DWD	n/a	n/a	n/a	n/a	n/a	n/a		311	285	290	285	n/a	n/a	n/a	n/a	
		S332DWS	n/a	n/a	n/a	n/a	n/a	n/a		287	250	291	283	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 C-5. WY2008 summary results of C-111 EO #9 dissolved organic carbon.

Type	Structure	Water Quality Station	Total Flow Volume (acre feet)	Dissolved Organic Carbon (mg/L)				
				1st	2nd	3rd	4th	Annual Average
Inflow	S332B	S332B	26,499	8.6	N/D [1]	N/D	N/D	8.6
	S332C	S332C	49,156	7.7	N/D	N/D	N/D	7.7
	S332D	S332D. S332DAS and S332DX	32,689	7.8	7.5	14.3	24.0	13.4
Interior	C1	CULC1	0	N/D	N/D	N/D	N/D	N/D
	C2	CULC2	0	N/D	N/D	N/D	N/D	N/D
Diversion	DS1	DS1	0	N/D	N/D	N/D	N/D	N/D
	DS2	DS2	0	N/D	N/D	N/D	N/D	N/D
	DS3	DS3	0	N/D	N/D	N/D	N/D	N/D
	DS4	DS4	0	N/D	N/D	N/D	N/D	N/D
Outflow	BERMB3	BERMB3	0	N/D	N/D	N/D	N/D	N/D

Notes:

1) N/D no data available

Attachment D: Time-Series and Box Plots of Total Phosphorus and Total Nitrogen at Monitoring Sites for Water Year 2008

Shi Kui Xue and Steven Hill

The graphs in this appendix depict total phosphorus (TP) and total nitrogen (TN) concentration data collected during Water Year 2008 (WY2008) (May 1, 2007 through April 30, 2008) for Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) water quality monitoring sites. The graph sequencing follows the station order shown in Attachment A, Table A-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.

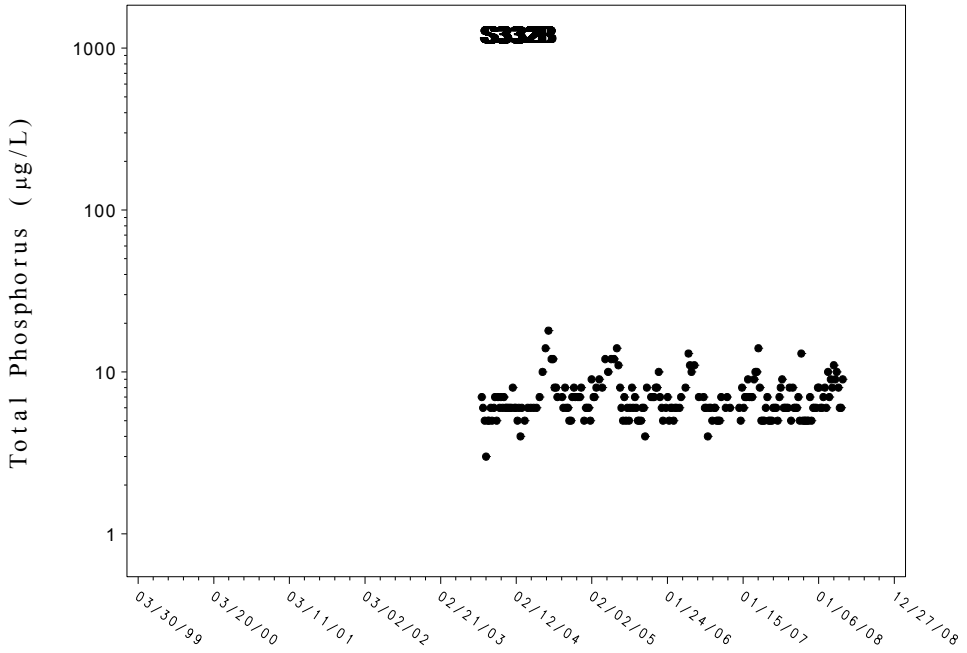

Figure D-1. TP concentration at S-332B.

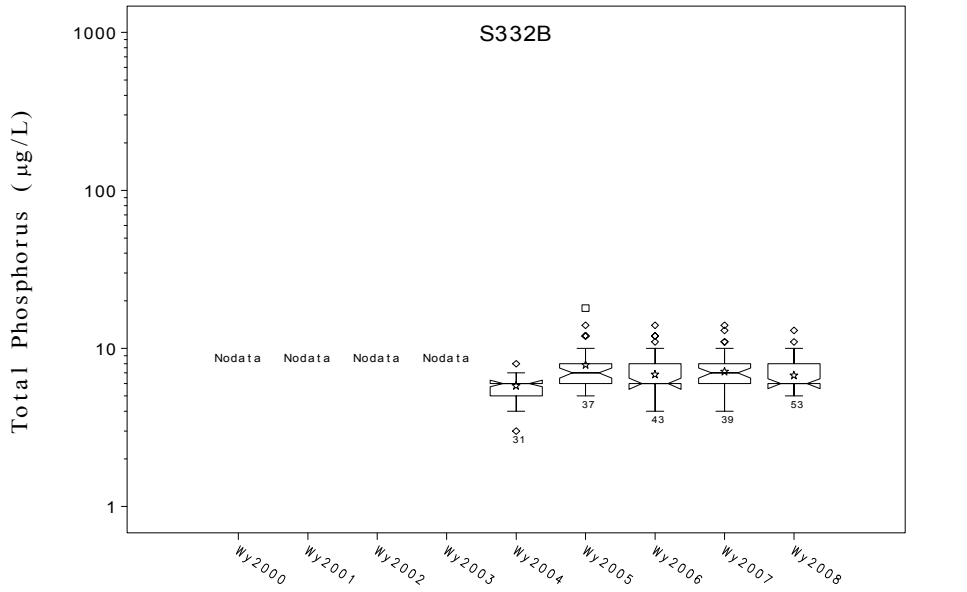

Figure D-2. TP notched box-and-whisker plot at S-332B.

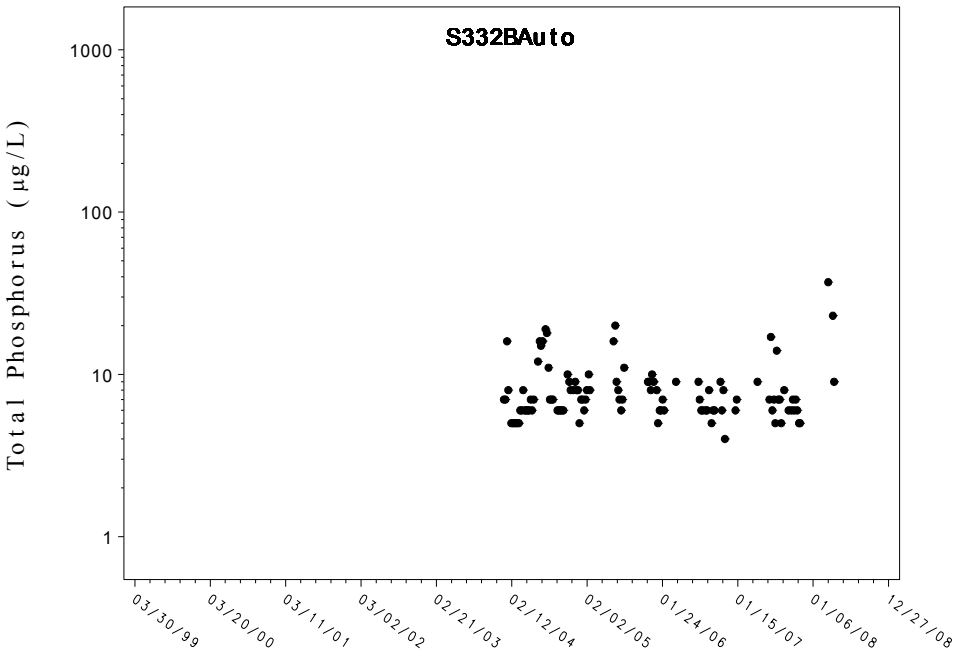

Figure D-3. TP concentration at S-332B auto-sampler.

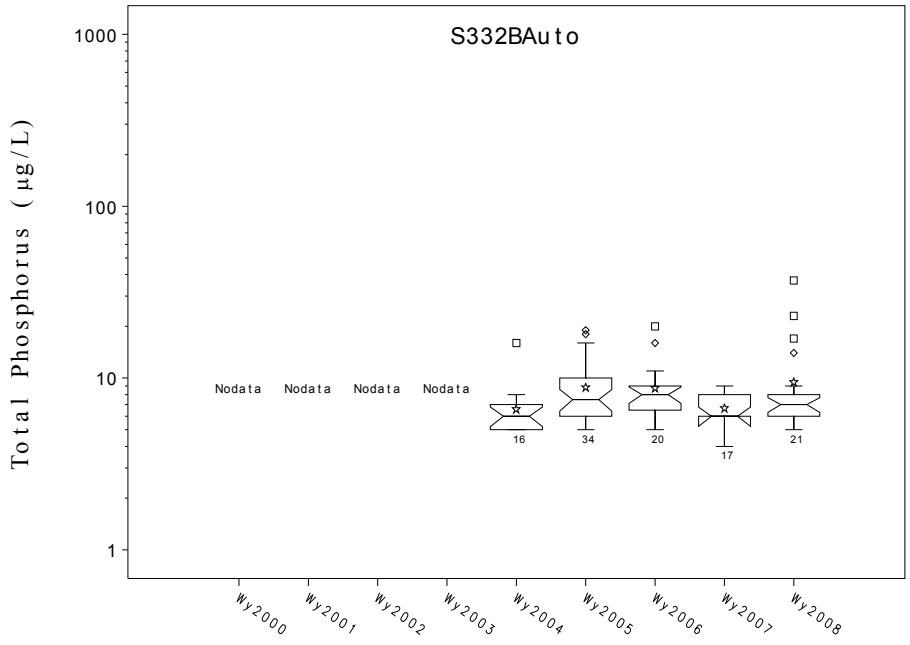

Figure D-4. TP notched box-and-whisker plot at S-332B auto-sampler.

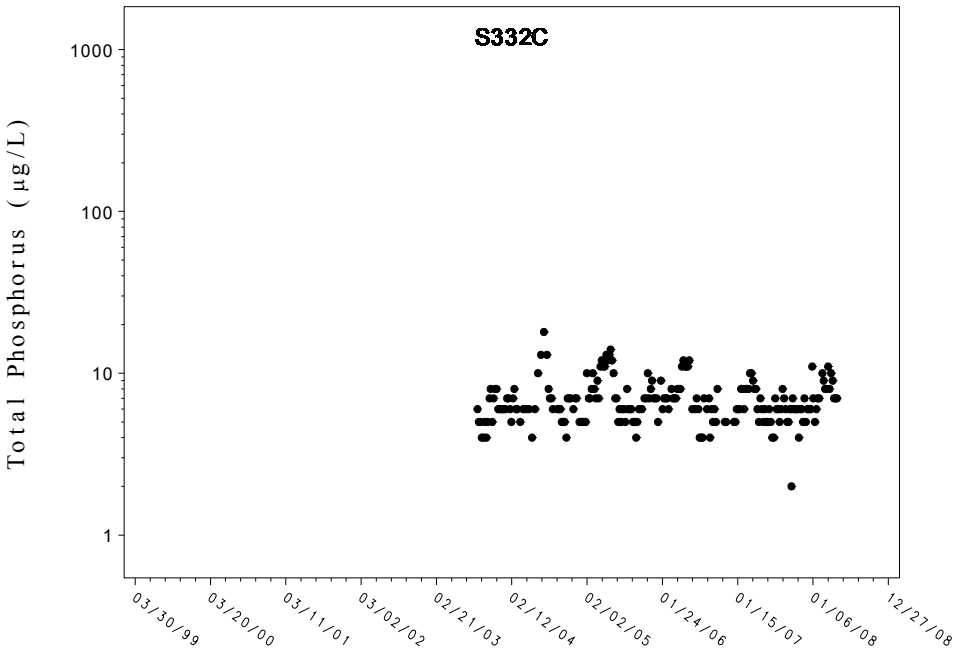

Figure D-5. TP concentration at S-332C.

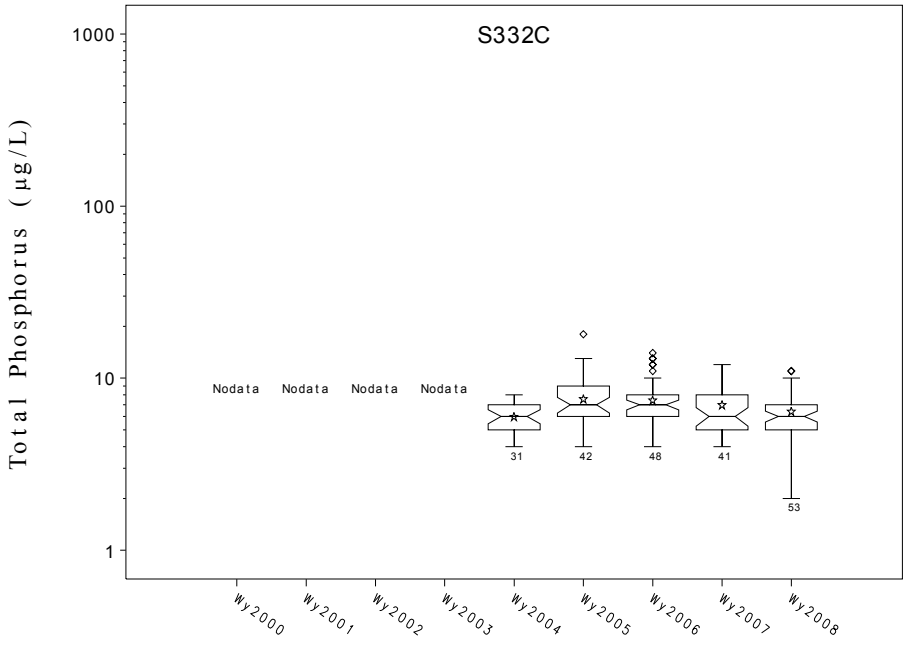

Figure D-6. TP notched box-and-whisker plot at S-332C.

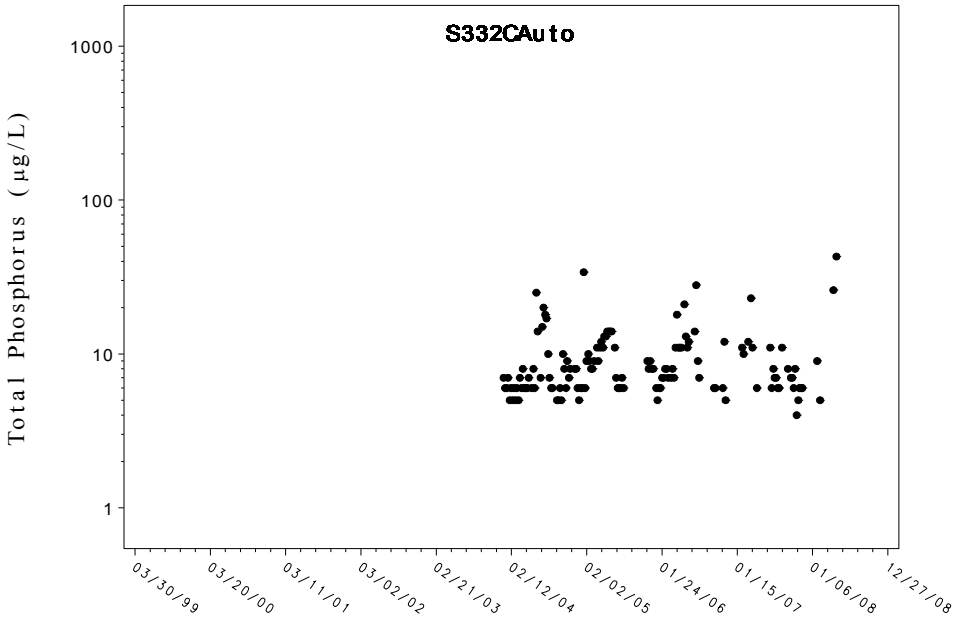

Figure D-7. TP concentration at S-332C auto-sampler.

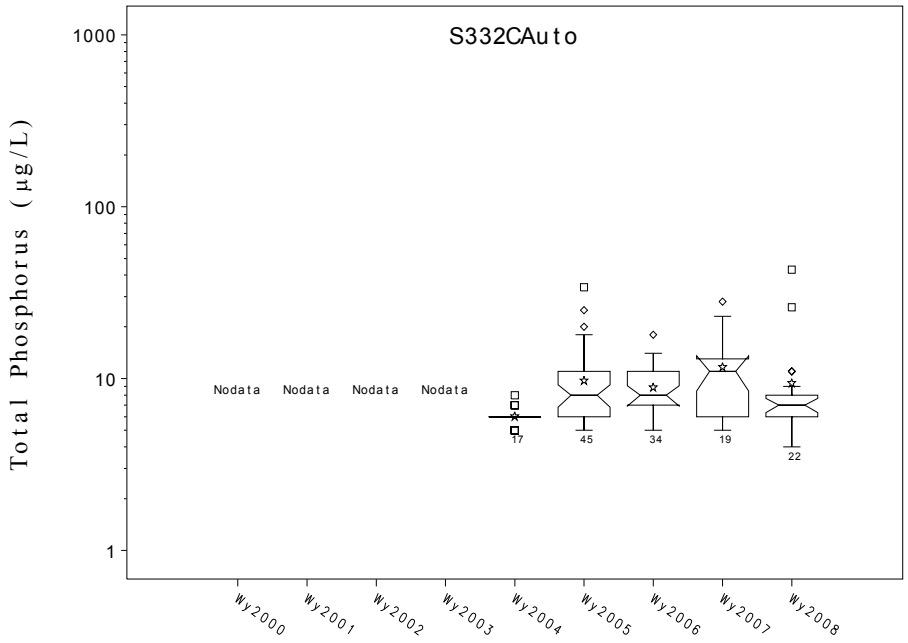

Figure D-8. TP notched box-and-whisker plot at S-332C auto-sampler.

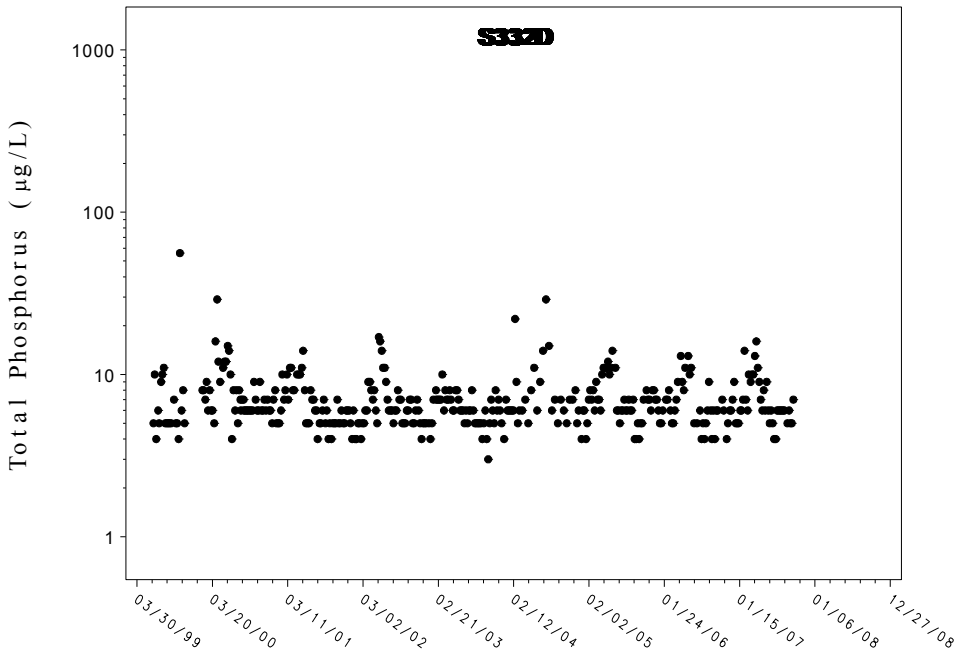

Figure D-9. TP concentration at S-332D.

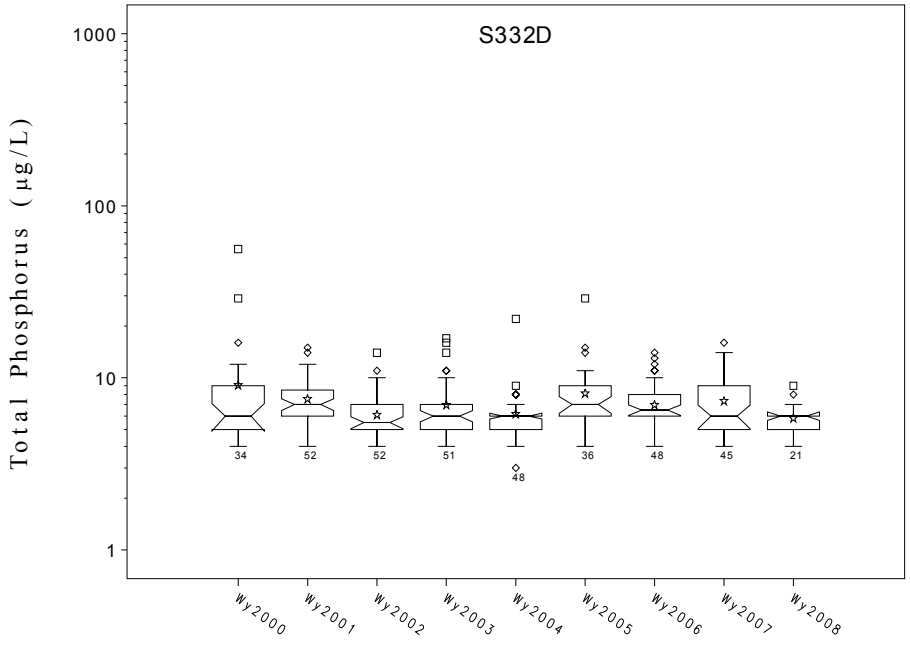

Figure D-10. TP notched box-and-whisker plot at S-332D.

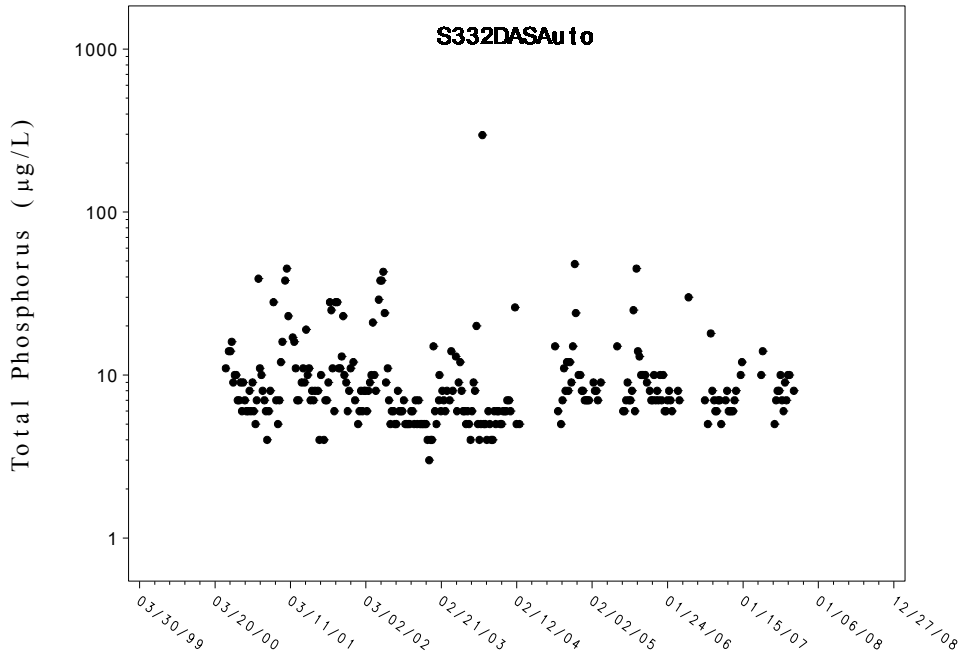

Figure D-11. TP concentration at S-332DAS auto-sampler.

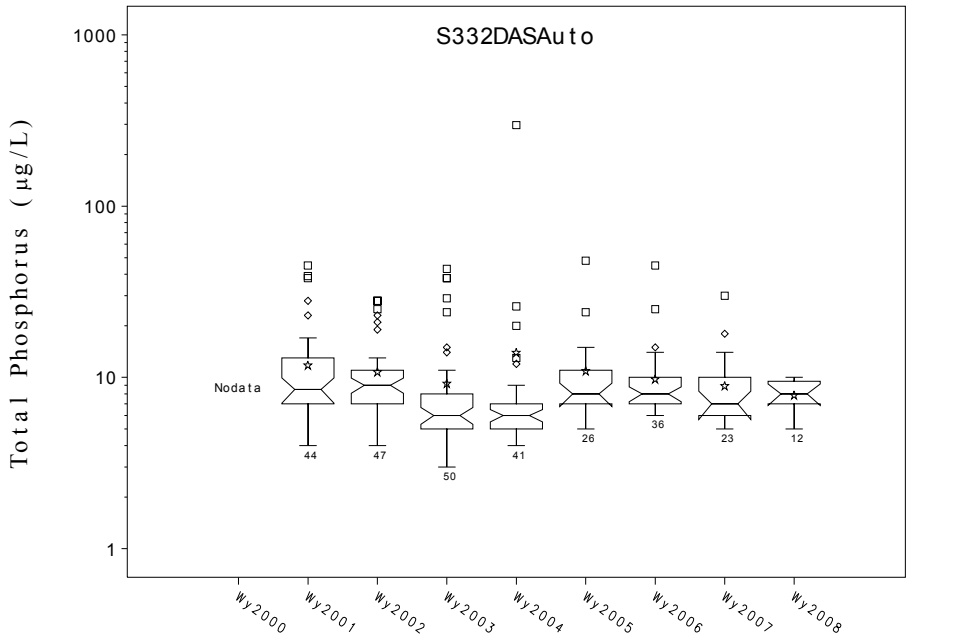

Figure D-12. TP notched box-and-whisker plot at S-332DAS auto-sampler.

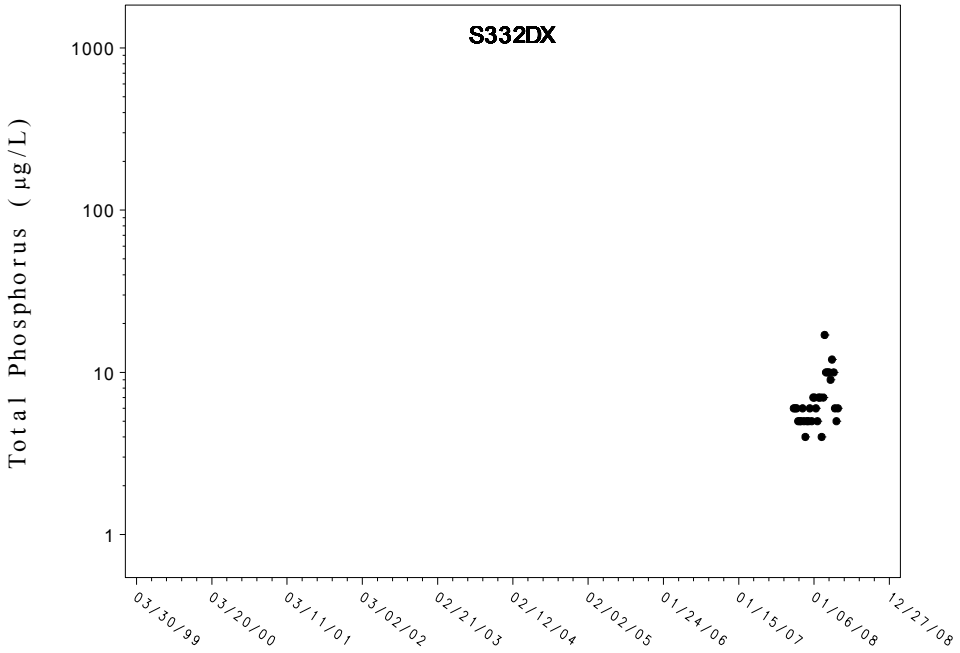

Figure D-13. TP concentration at S-332DX.

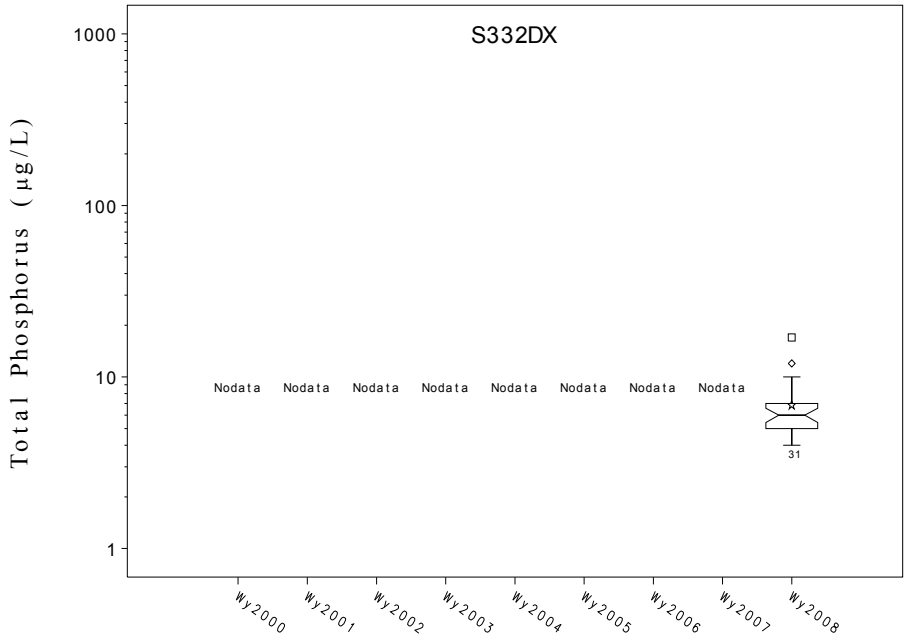

Figure D-14. TP notched box-and-whisker plot at S-332DX.

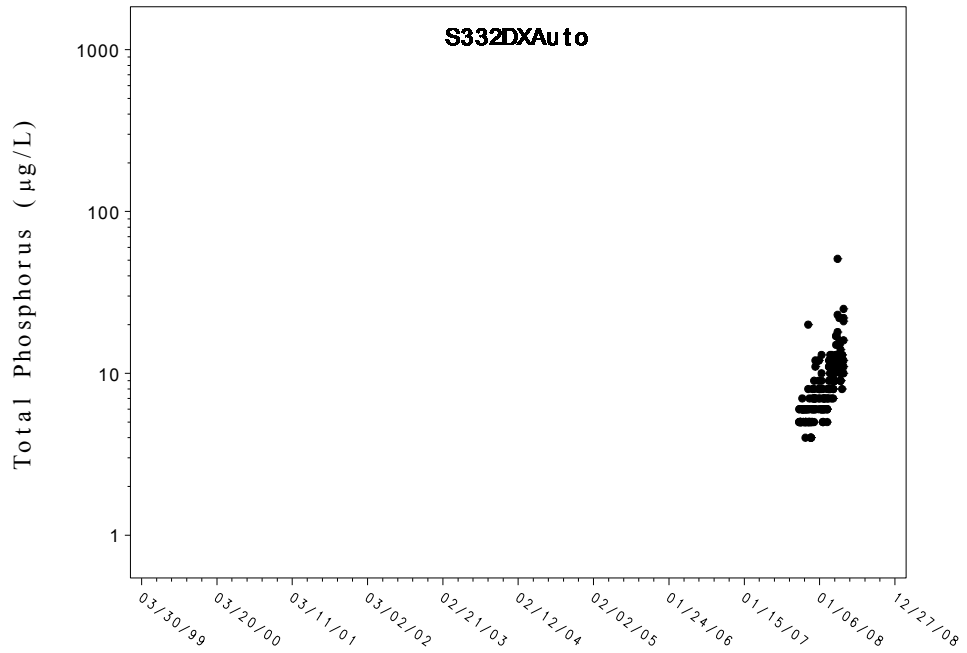

Figure D-15. TP concentration at S-332DX auto-sampler**.**

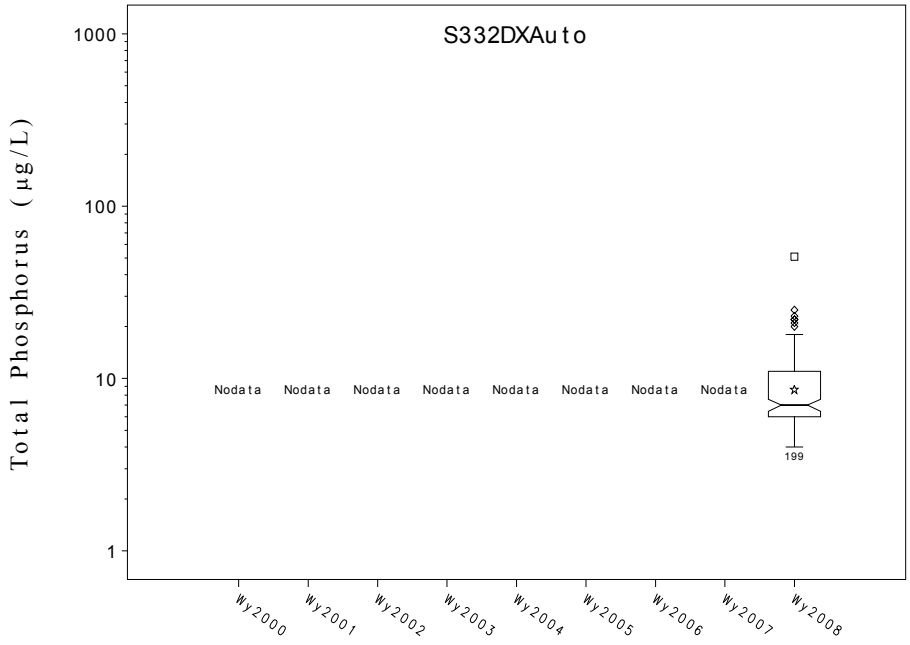

Figure D-16. TP notched box-and-whisker plot at S-332DX auto-sampler**.**

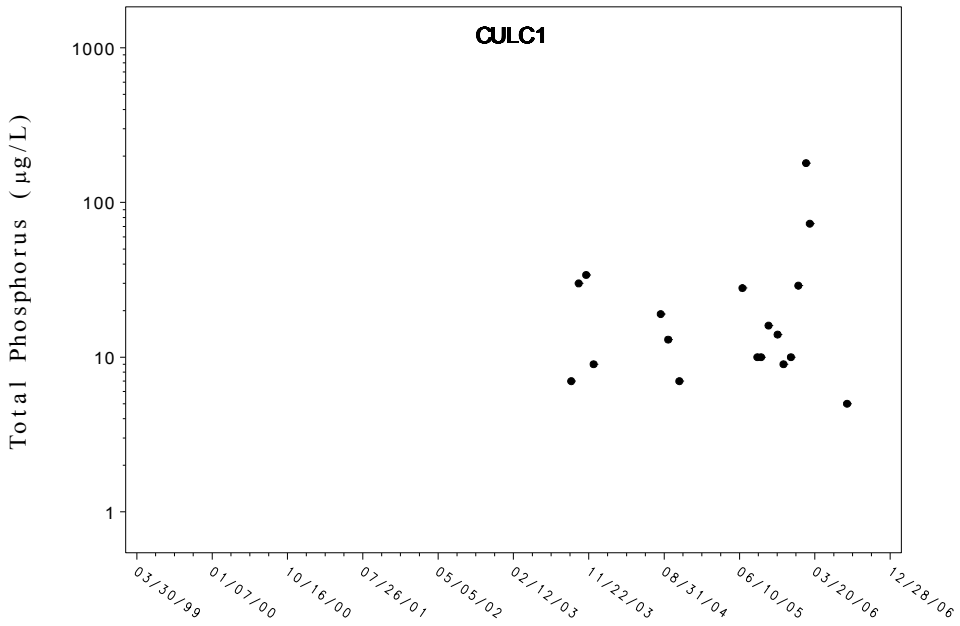

Figure D-17. TP concentration at CULC1.

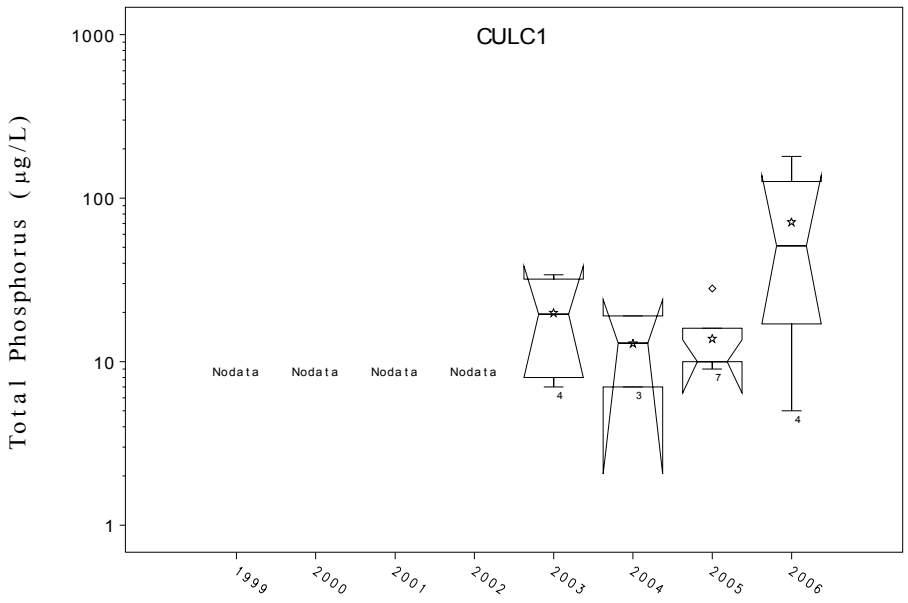

Figure D-18. TP notched box-and-whisker plot at CULC1**.**

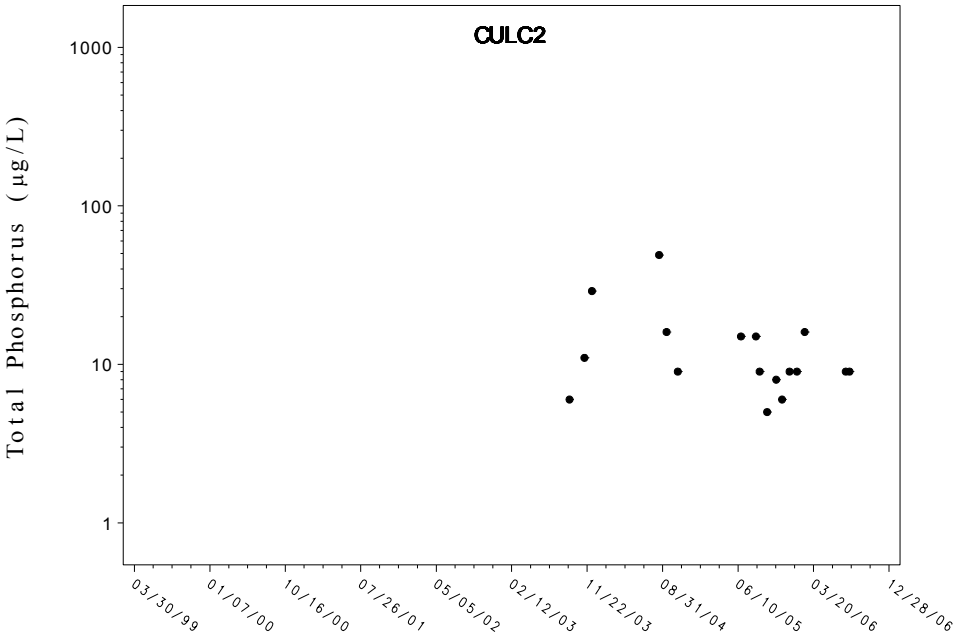

Figure D-19. TP concentration at CULC2.

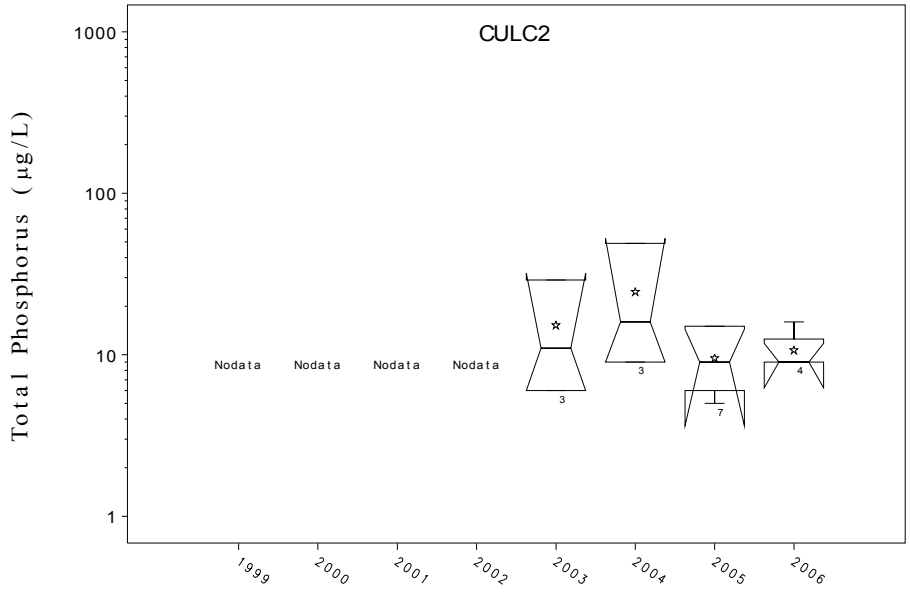

Figure D-20. TP notched box-and-whisker plot at CULC2**.**

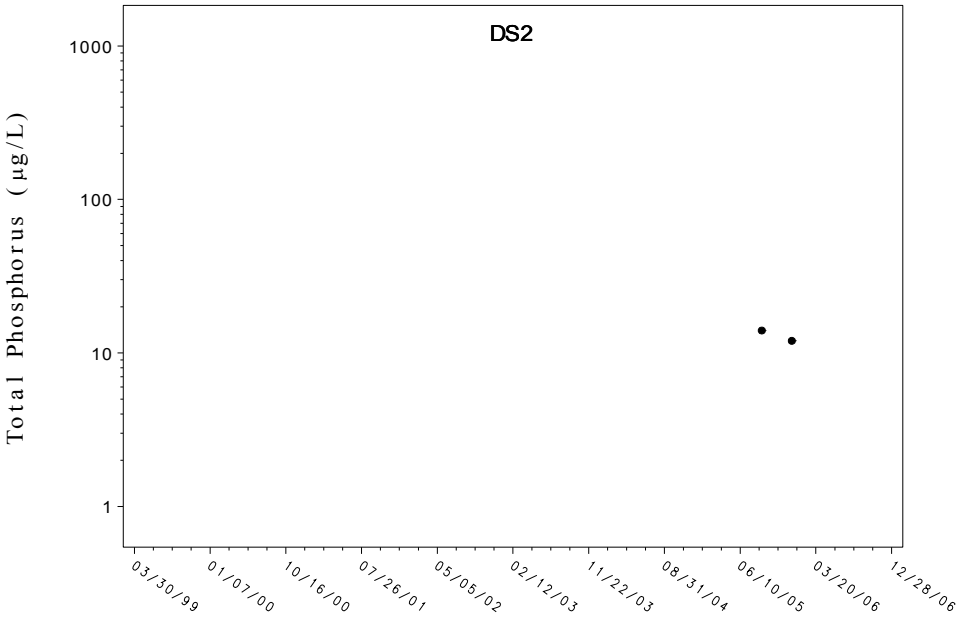

Figure D-21. TP concentration at DS2.

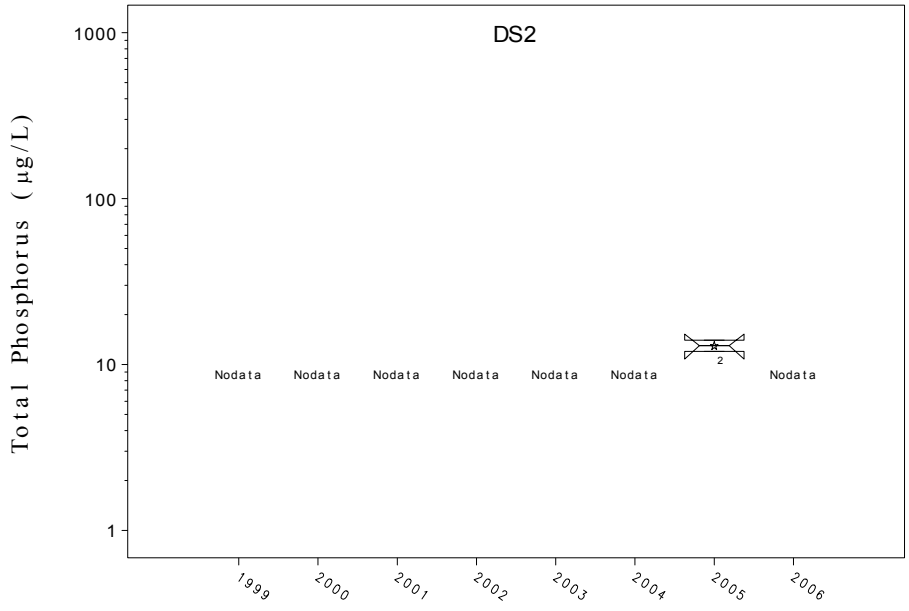

Figure D-22. TP notched box-and-whisker plot at DS2.

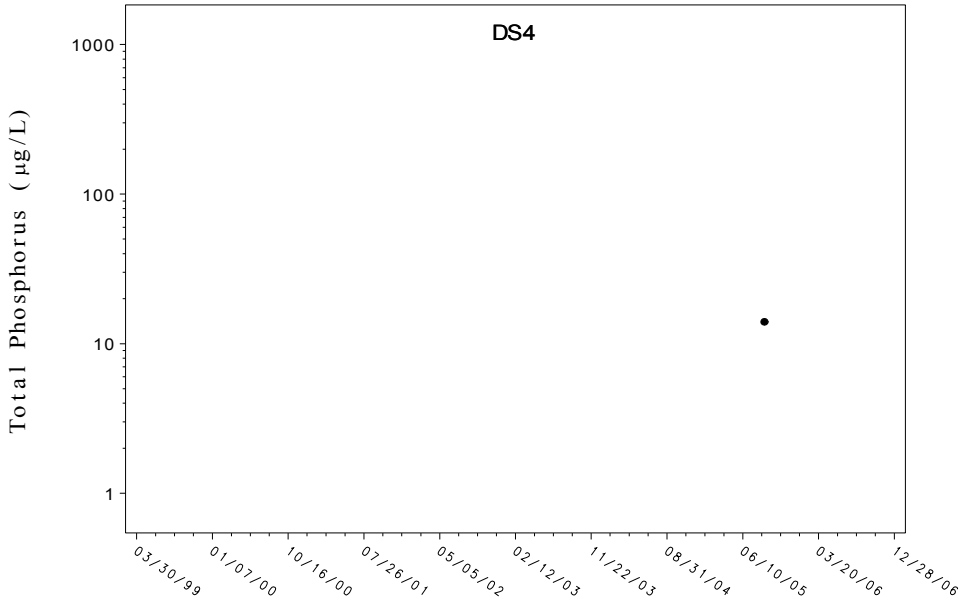

Figure D-23. TP concentration at DS4.

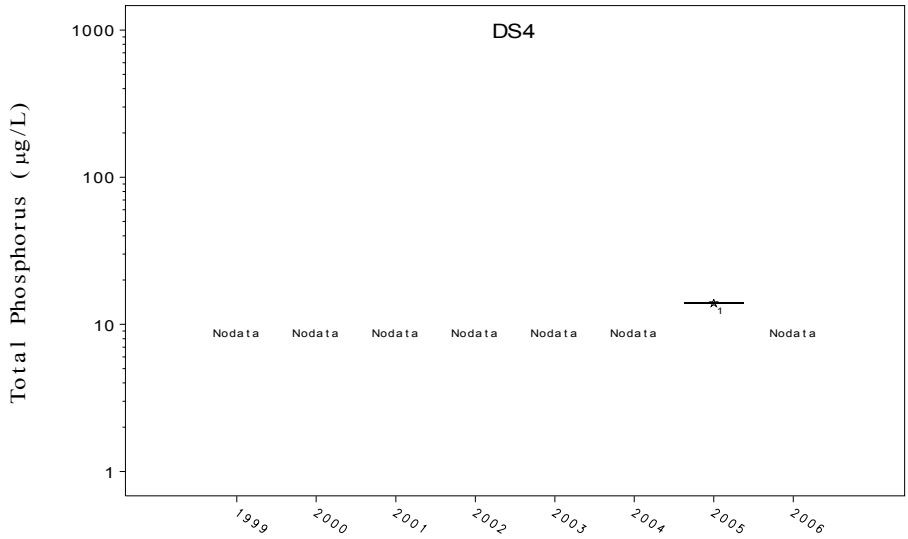

Figure D-24. TP notched box-and-whisker plot at DS4.

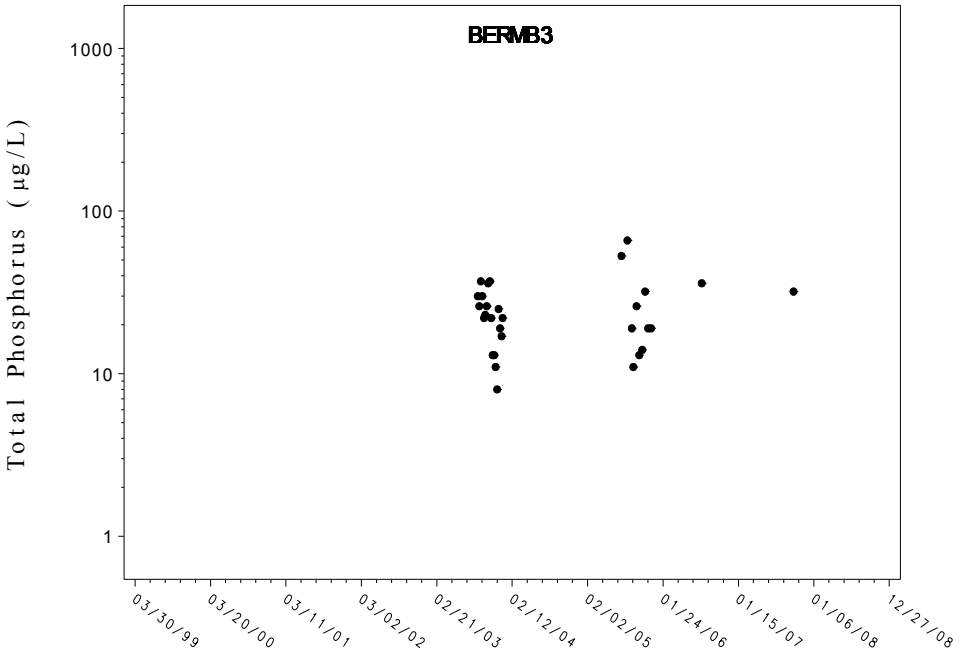

Figure D-25. TP concentration at BERMB3.

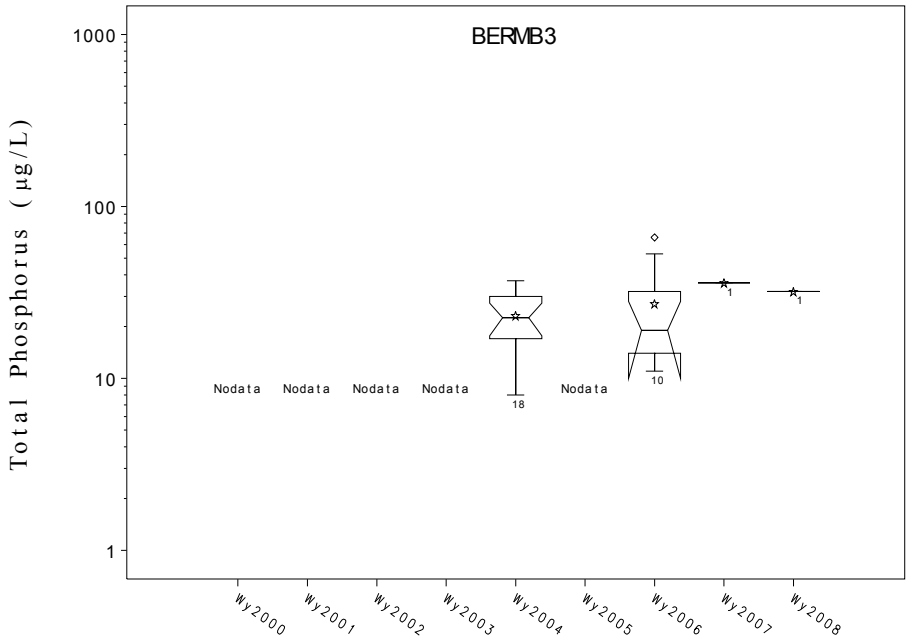

Figure D-26. TP notched box-and-whisker plot at BERMB3.

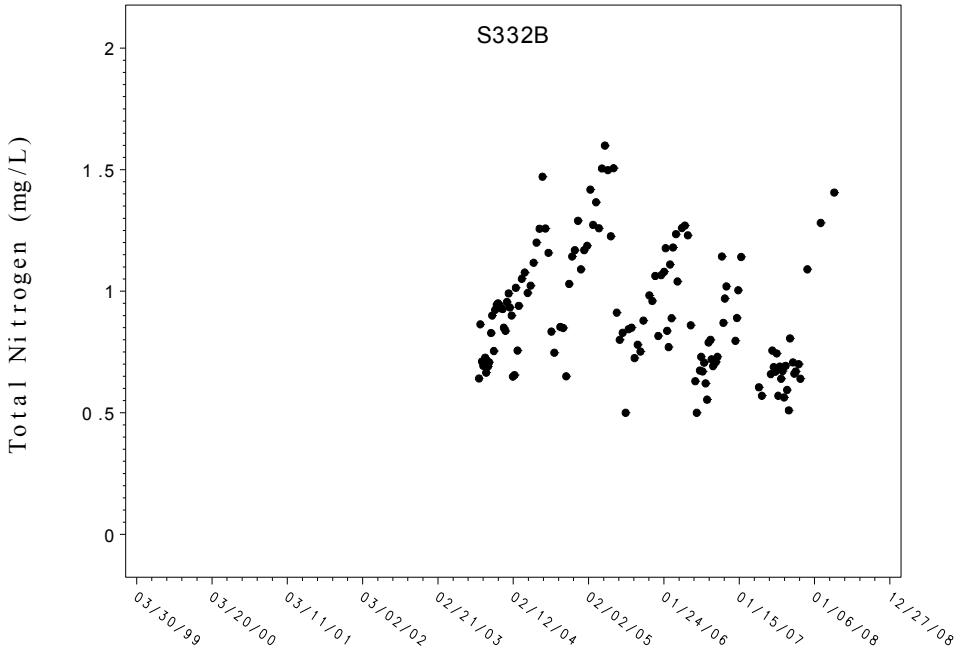

Figure D-27. TN concentration at S332B.

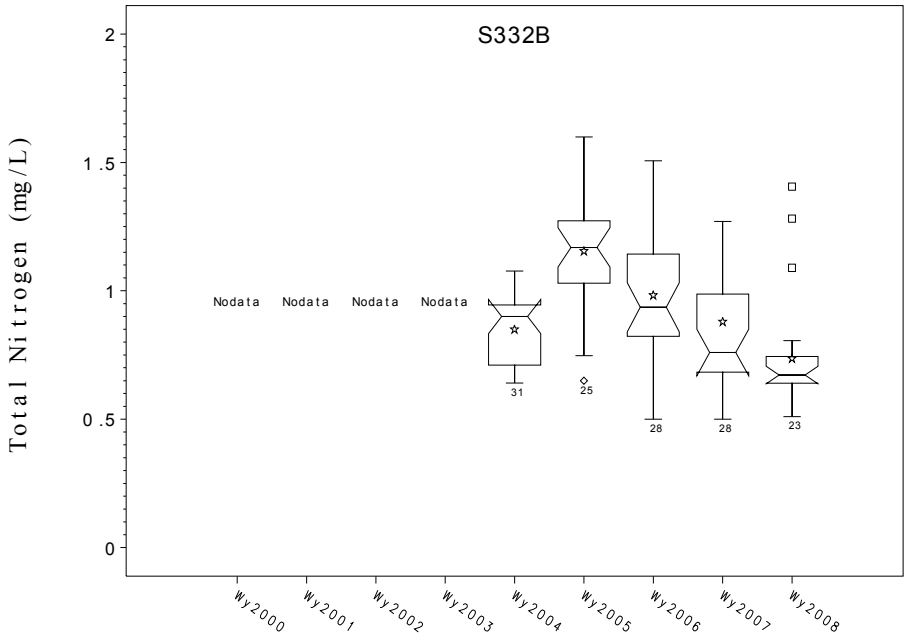

Figure D-28. TN notched box-and-whisker plot at S332B.

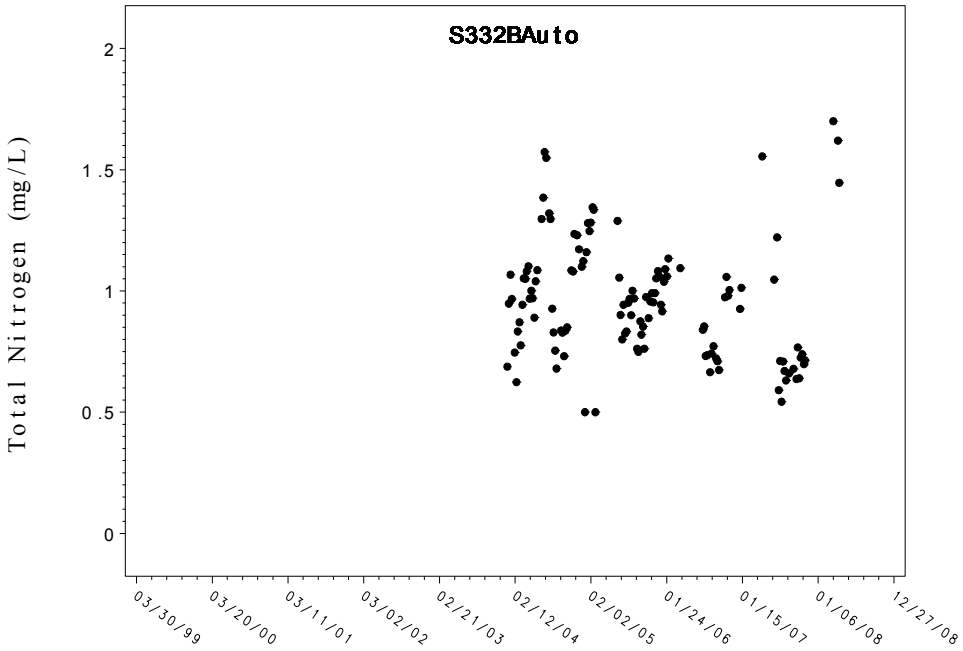

Figure D-29. TN concentration at S332B auto-sampler.

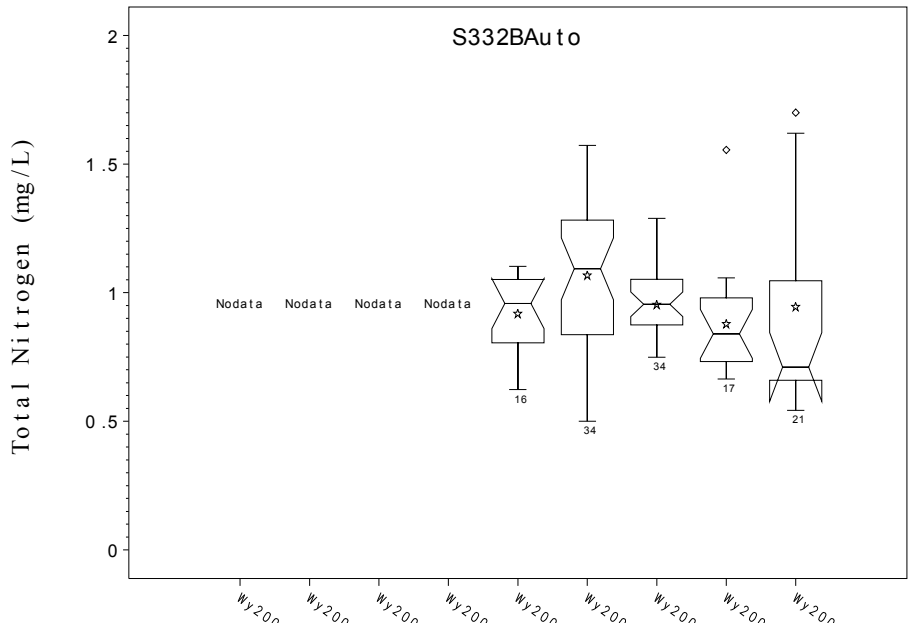

Figure D-30. TN notched box-and-whisker plot at S332B auto-sampler.

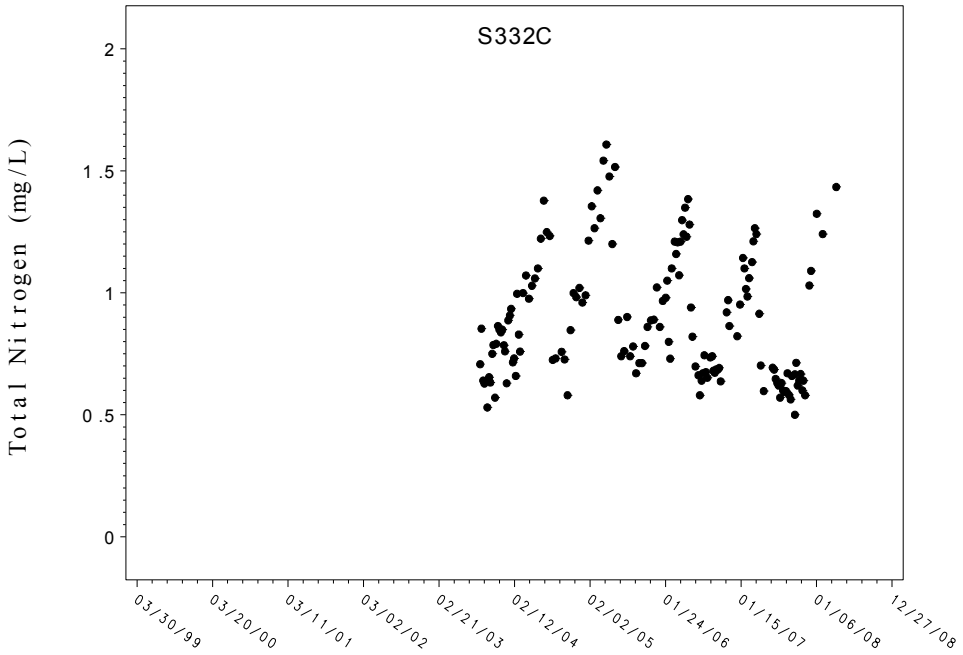

Figure D-31. TN concentration at S332C.

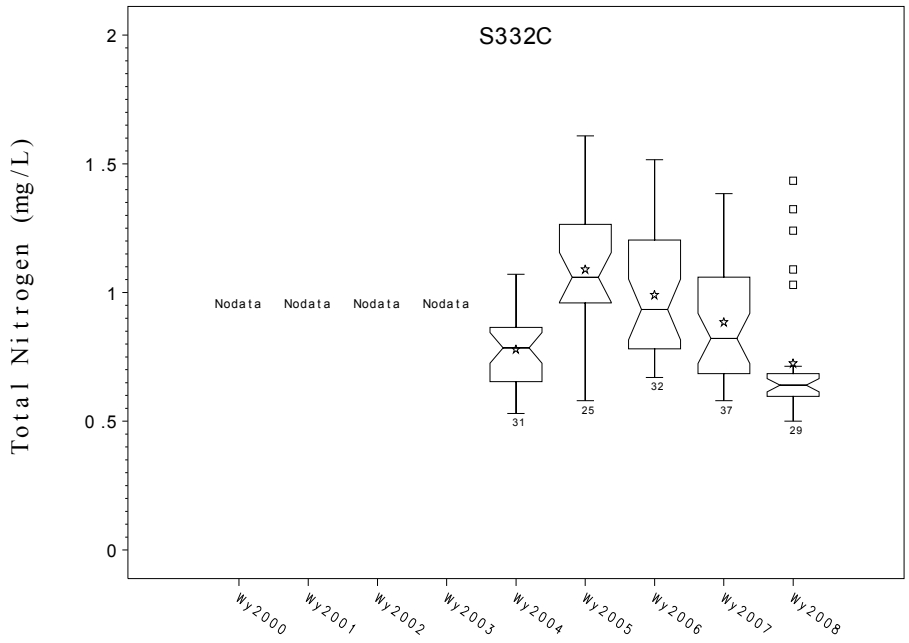

Figure D-32. TN notched box-and-whisker plot at S332C.

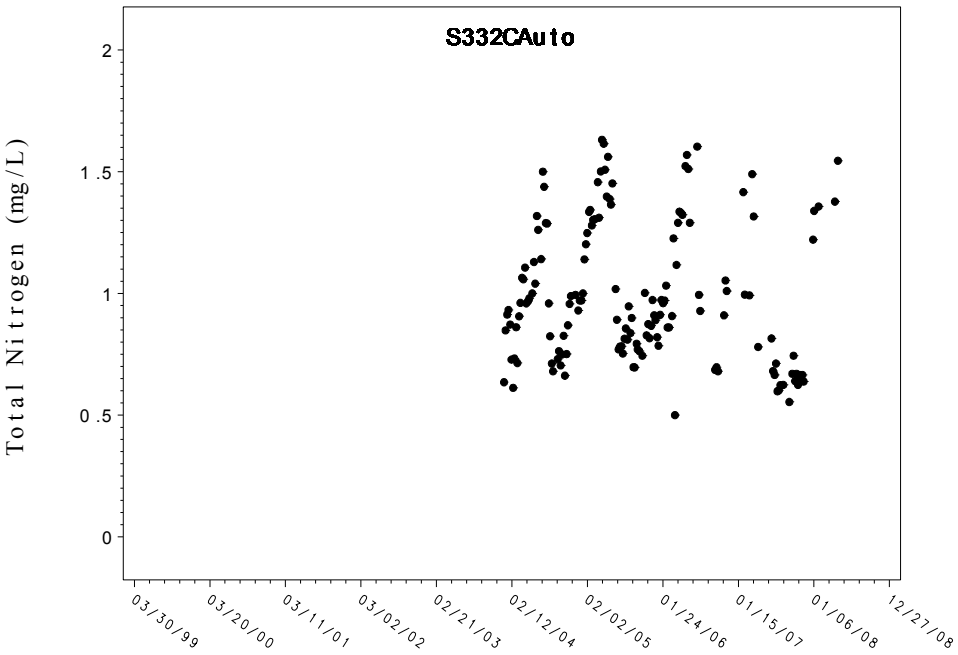

Figure D-33. TN concentration at S332 auto-sampler.

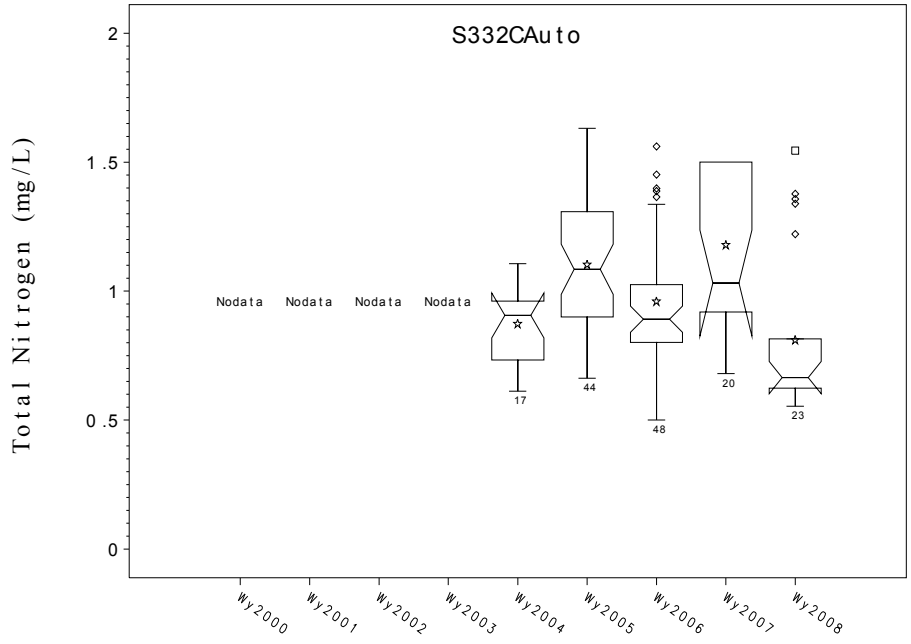

Figure D-34. TN notched box-and-whisker plot at S332C auto-sampler.

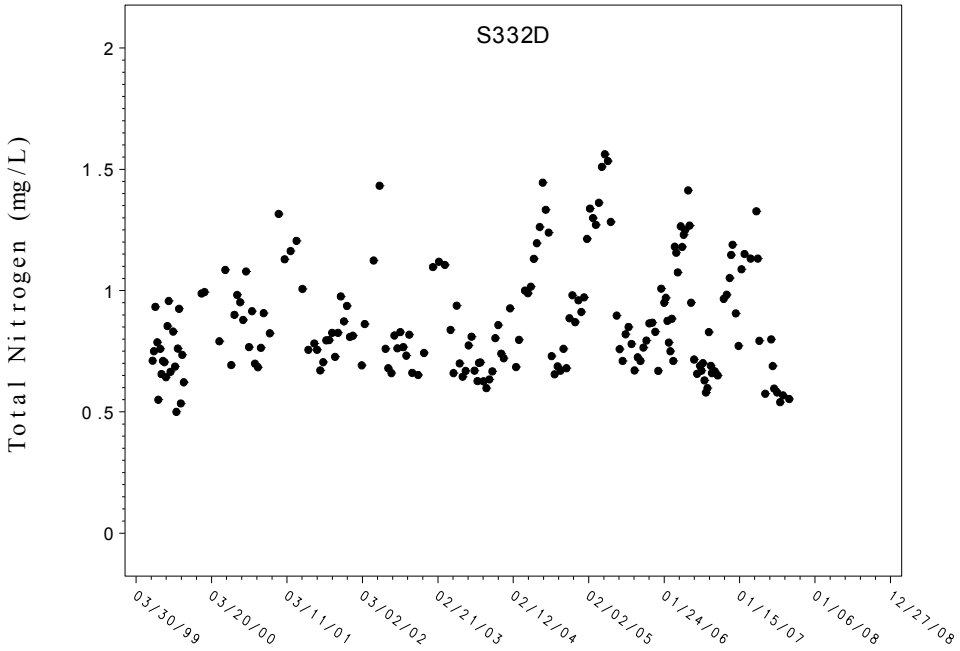

Figure D-35. TN concentration at S332D.

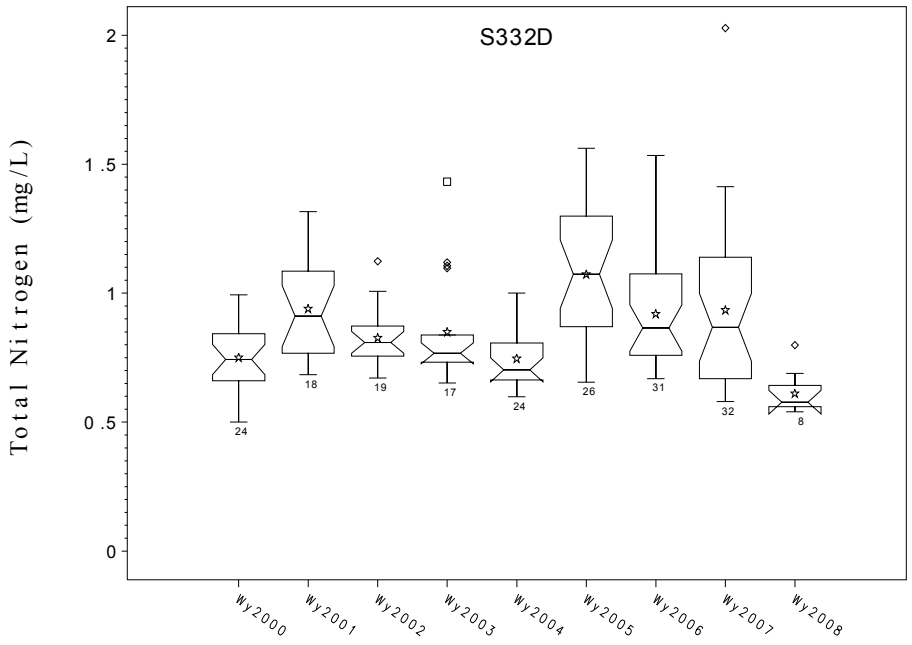

Figure D-36. TN notched box-and-whisker plot at S332D.

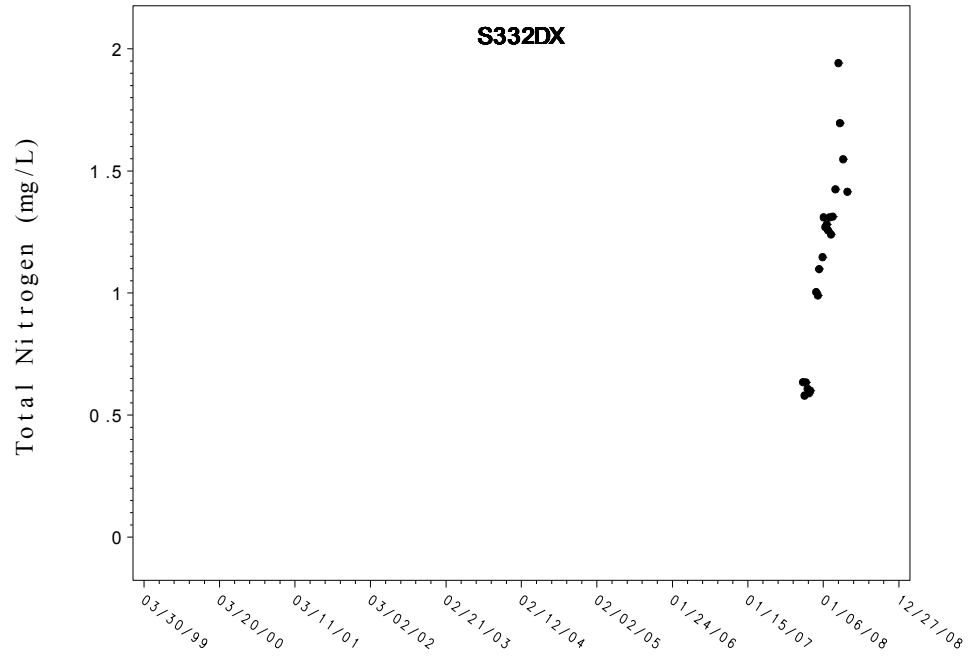

Figure D-37. TN concentration at S332DX.

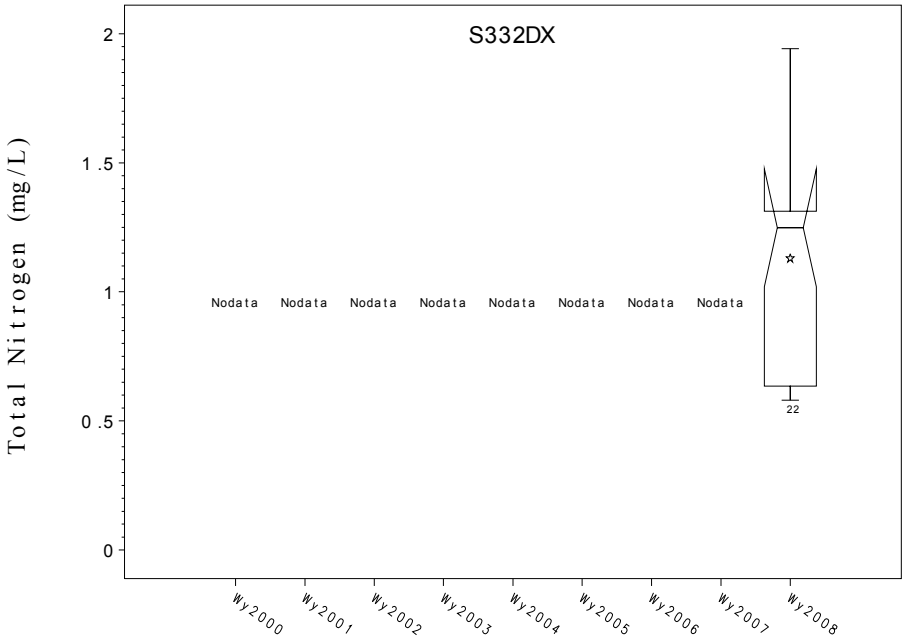

Figure D-38. TN notched box-and-whisker plot at S332DX.

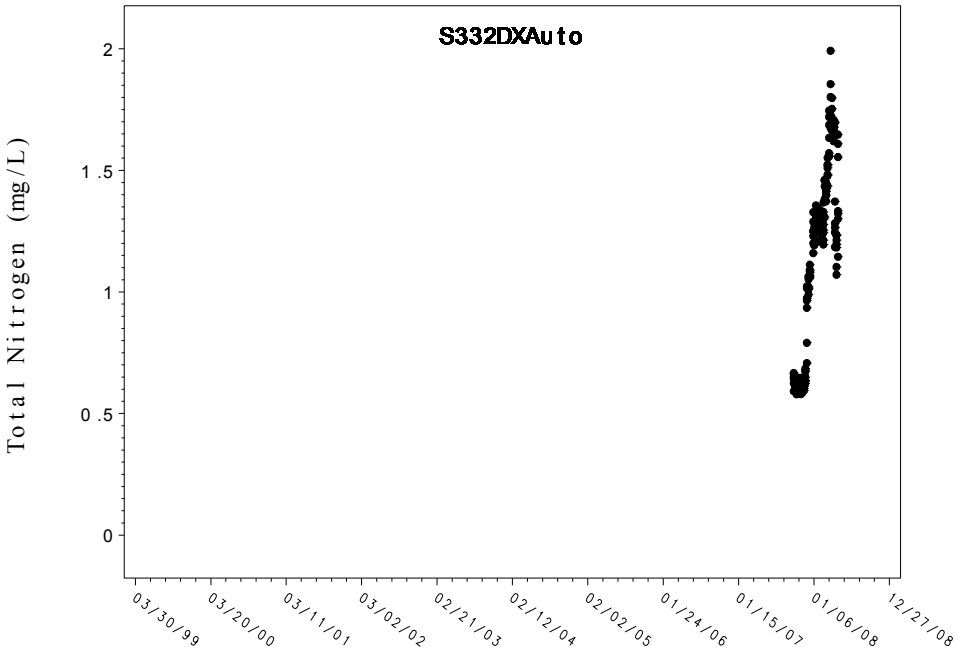

Figure D-39. TN concentration at S332DX auto-sampler.

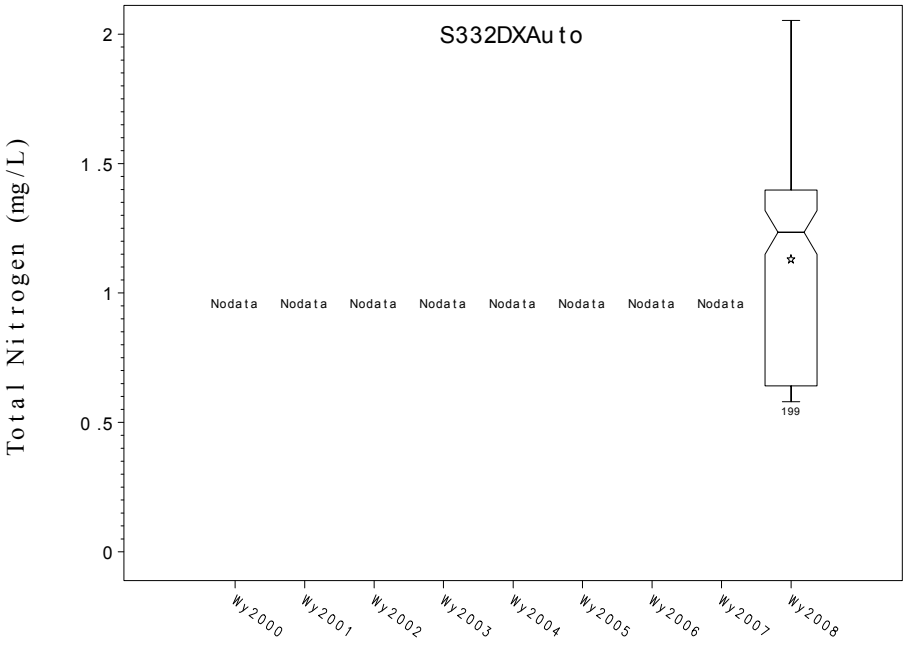

Figure D-40. TN notched box-and-whisker plot at S332DX auto-sampler.

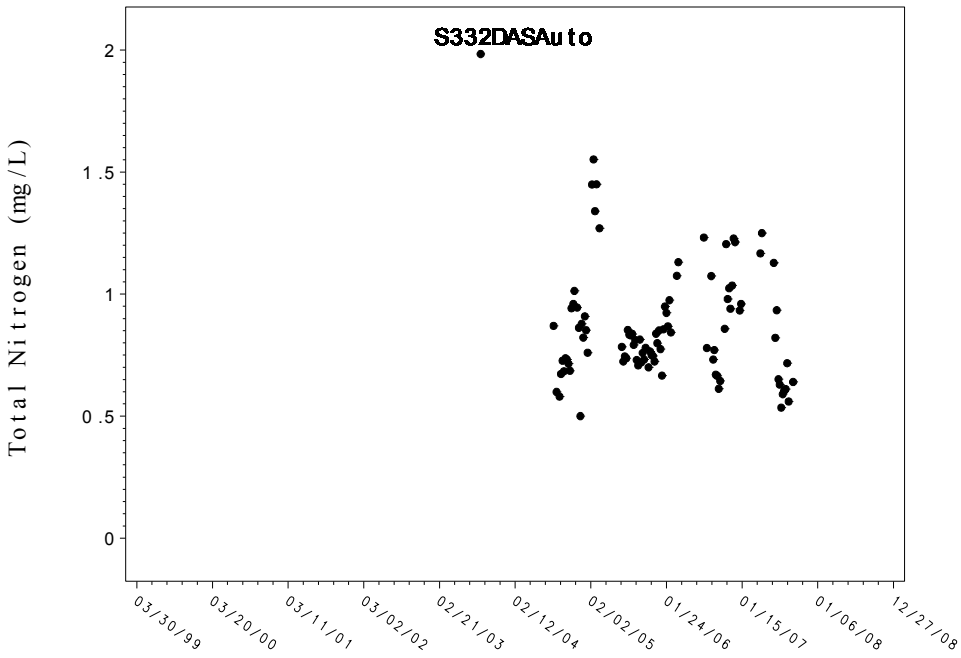

Figure D-41. TN concentration at S332DAS auto-sampler.

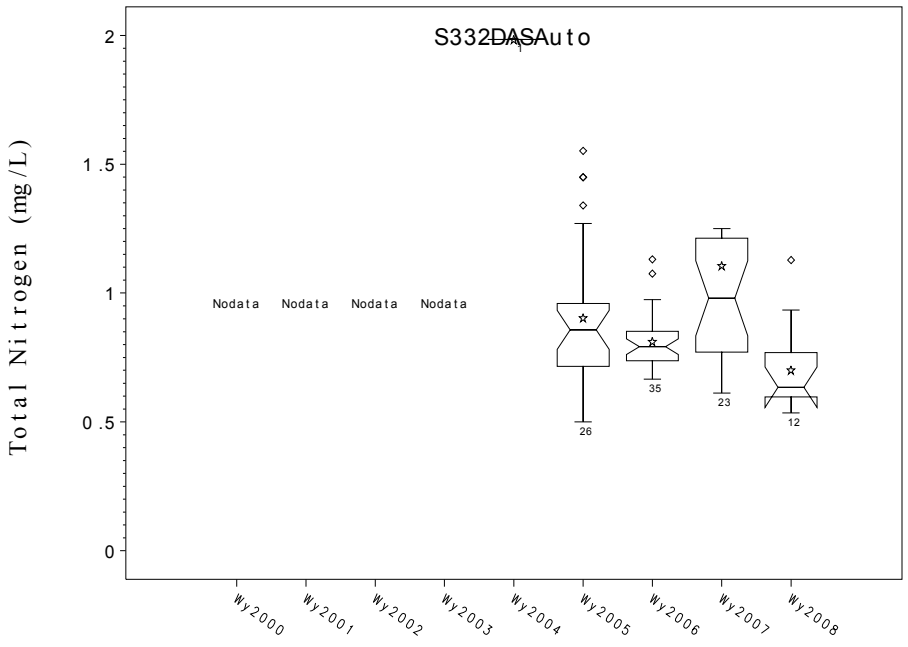

Figure D-42. TN notched box-and-whisker plot at S332DAS auto-sampler.

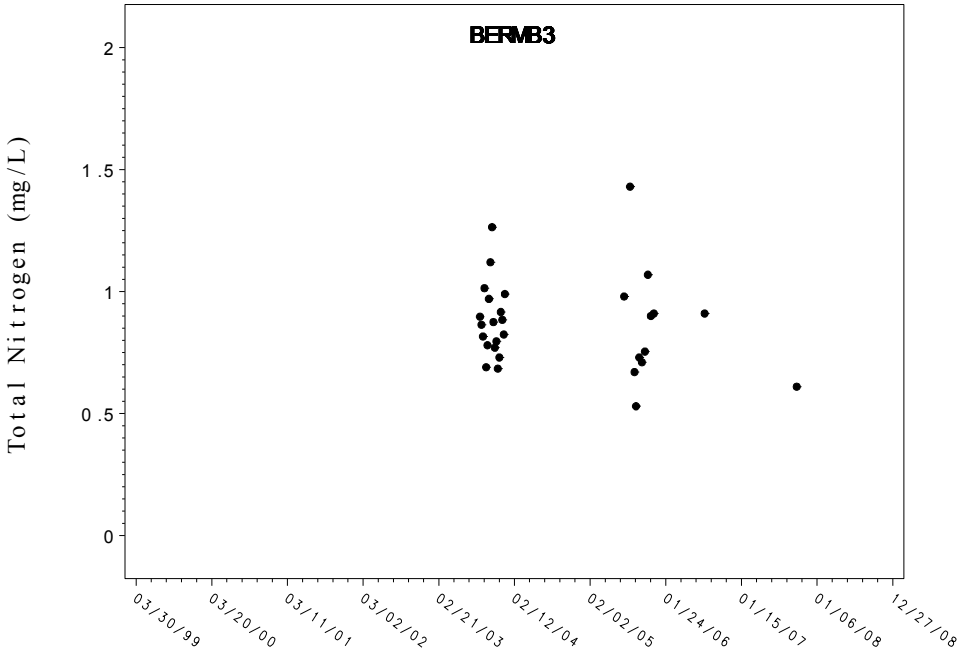

Figure D-43. TN concentration at BERMB3.

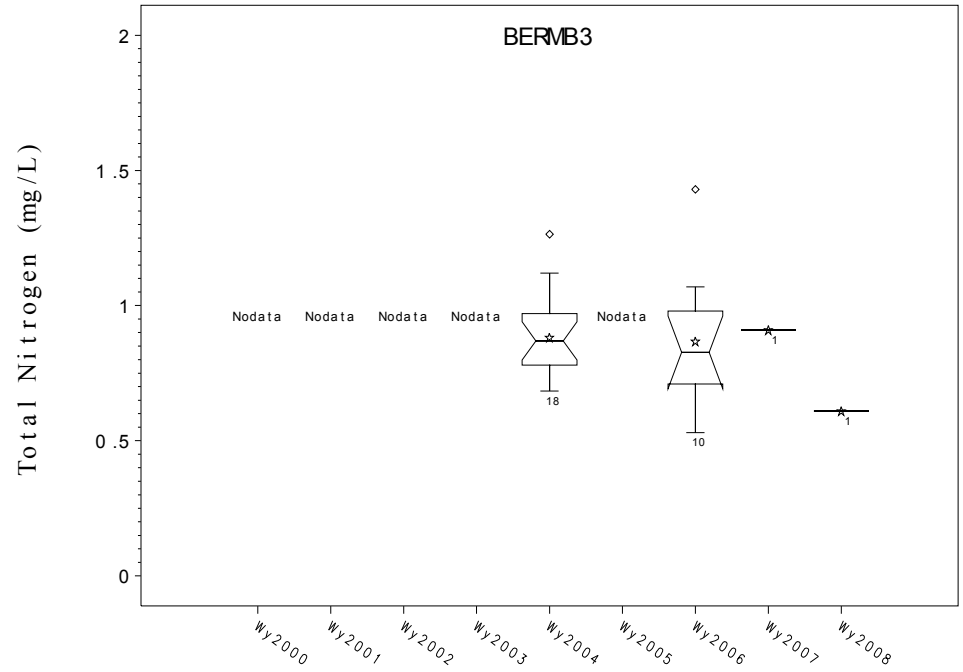

Figure D-44. TN notched box-and-whisker plot at BERMB3.