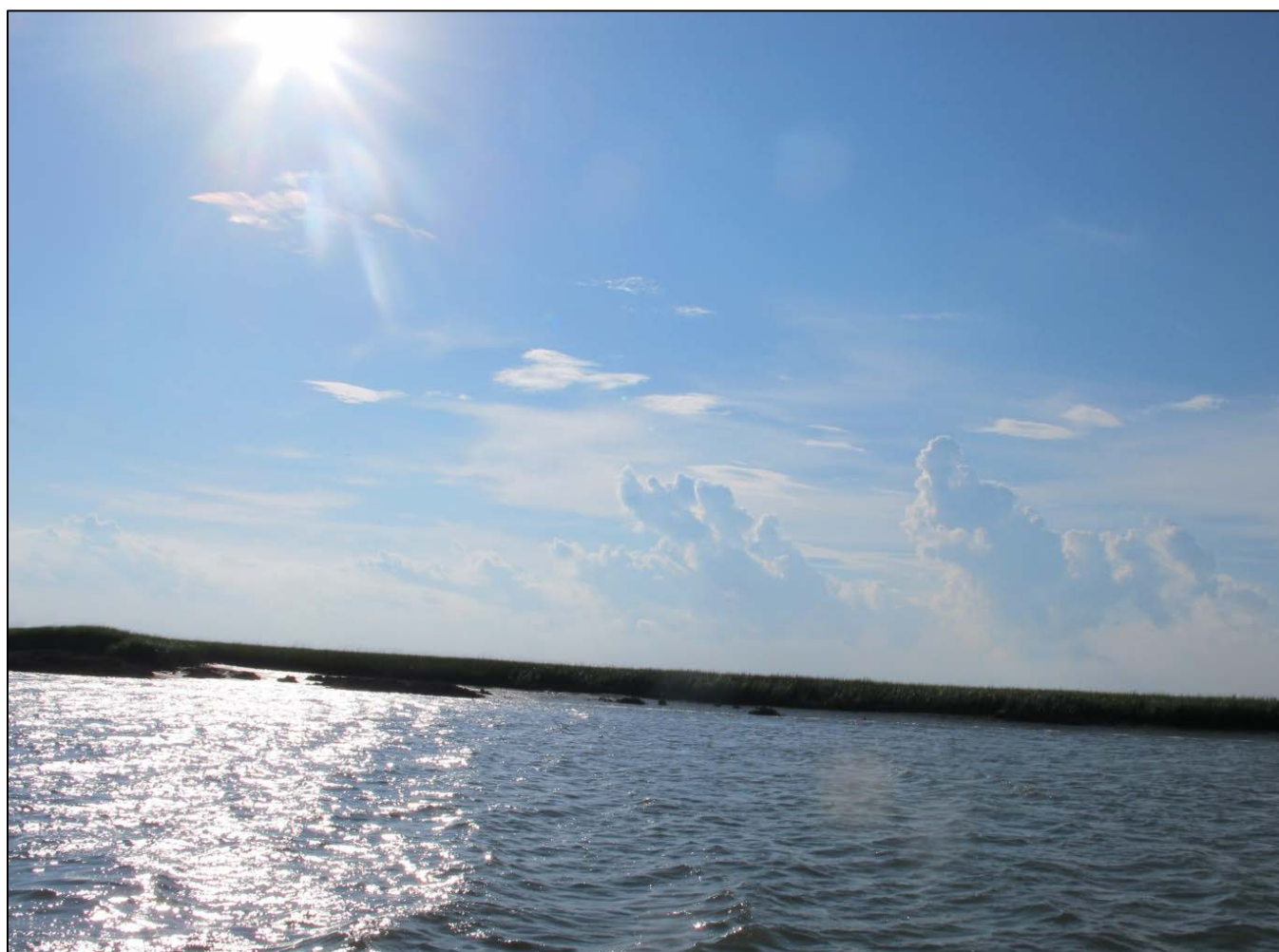




Fixed-Station Water-Quality Monitoring at Fort Pulaski National Monument

2006-2009 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2014/699



ON THE COVER

South Channel of the Savannah River, adjacent to Fort Pulaski National Monument
Photo by Brian Gregory, SECN Staff

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2006-2009 Data Summary

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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Summary and Key Findings

In 2006 the National Park Service (NPS) Southeast Coast Network (SECN) Inventory and Monitoring Program began collecting water-quality data in the estuarine waters near Fort Pulaski National Monument (FOPU) as part the NPS Vital Signs monitoring program. The continuous monitoring data station is approximately 1.5 kilometers south of the Fort entrance at a dock on Lazaretto Creek just upstream of its confluence with the Savannah River. This station collects pH, dissolved oxygen, water temperature, salinity, specific conductance, turbidity and water level data every 30 minutes. Additional water-quality measurements are made by SECN staff and include monthly measurements of water-clarity conditions, nutrients, and chlorophyll *a* levels. Methods used are adapted from the water-quality monitoring program established by the National Estuarine Research Reserve Program (Wenner and Geist 2001). The Fort Pulaski National Monument fixed-station water-quality monitoring site is part of the SECN estuarine water-quality monitoring program, which routinely collects data in the vicinity of seven coastal parks located along the southeastern U.S. coast (Gregory et al. 2013). Information collected by this monitoring program will be used to help managers make better-informed decisions by understanding trends and variability related to water-quality conditions in park waters. Summary data are presented in annual data reports published by the SECN. Findings for 2006-2009 are as follows:

- Continuous data variables were collected at 30-minute intervals for the date range of August 2006 through December 31, 2009. All parameters vary seasonally, diurnally, and/or with tidal cycles and weather events.
- Water temperature at Fort Pulaski National Monument ranged from a low of 7.4°C in January of 2009 to a high of 32.3°C in August, 2007. Mean monthly water temperatures ranged from 11.5°C in January, 2008 to 30.0°C in August, 2007.
- Salinity ranged from 9.1 ppt in April, 2009 to a high of 35.9 ppt in August, 2008. Monthly mean salinity ranged from 19.5 ppt in April, 2009 to 27.6 ppt in May, 2008.
- Dissolved oxygen ranged from 2.3 mg/L in September, 2009 to a high of 11.7 mg/L in August, 2008. Monthly means ranged from 4.7 mg/L in August, 2007, to 9.1 mg/L in February 2007 and February 2009.
- Individual pH readings ranged from 7.1 in August 2009 to 8.4 in November of 2008. Monthly means for pH ranged from 7.5 in August and September of 2009 to 8.1 in November and December of 2008.
- Turbidity readings ranged from 1.2 NTU in August of 2007 to a high of 993.1 NTU in July, 2009. Monthly means for turbidity range from 16.7 in September, 2009 to 128.4 NTU in August of 2008.
- Water depth measurements indicated tidal range of approximately 4 meters across the period of record, reflective of the large tidal influence along the Georgia coast.

- Thirty-eight monthly discrete data samples were collected.
- Water clarity was *good* 76% of the time and *poor* 16% of the time, with *poor* readings occurring in the months of April through November in various years. Two sampling dates (5%) did not have water clarity data.
- Dissolved oxygen was *good* 89% of the time, with 11% rating *fair*. *Fair* readings occurred in the summer months of May through August.
- Chlorophyll *a* levels were *fair* 76% of the time, with one month's data (3%) indicating *poor* conditions in September, 2007. During three months chl *a* levels (8%) were *good*, with all *good* results occurring in the month of December.
- Dissolved inorganic nitrogen and dissolved inorganic phosphorus samples were taken quarterly, with a total of ten sampling dates. Dissolved inorganic nitrogen was *good* 60% of the time and *fair* 40%, while dissolved inorganic phosphorus was *fair* 90% of the time and *poor* 10%.
- Anomalous and missing data during 2006-2009 were most commonly associated with pH probe failure, temperature probe failure, calibration issues with depth, turbidity spikes reading outside the limits of the sonde, and mount and equipment issues.

Introduction

Because of the importance of water resources to park management from ecological, regulatory, and visitor experience perspectives, marine water quality in and around parks was selected as one of several Vital Signs to be monitored by the I&M program (DeVivo et al. 2008). Data collected as a part of this effort are intended to foster a better understanding of water resources in and around parks, and contribute to an increased awareness of park ecological processes and physical systems (Gregory et al. 2013).

To effectively monitor the diverse and dynamic set of estuarine water resources, the SECN has implemented a two-pronged monitoring approach consisting of collecting data from continuously recording fixed stations located in each park and also collecting periodic discrete water samples for analysis (Gregory et al. 2013). When combined, these two approaches give a more complete picture of physical processes, diurnal and seasonal variations, and spatial patterns during critical portions of the year than either could if implemented singularly.

The SECN has identified four specific monitoring objectives for which data are collected and analyzed (Gregory et al. 2013).

1. Determine daily and seasonal water-quality patterns for five core parameters (dissolved oxygen, salinity, temperature, pH, and turbidity) at fixed monitoring stations using continuous data loggers.
2. Determine monthly and seasonal patterns in nutrients (nitrogen, phosphorus, and chlorophyll *a*) at fixed monitoring stations by collecting discrete water samples.
3. Determine status and spatial variability of water and nutrient chemistry conditions in estuarine waters every five years.
4. Determine status and spatial variability of benthic sediment quality (organic contaminants, carbon, and metal levels) every ten years in estuarine waters.

This report provides a summary of data collected at this site during 2006 through 2009 and provides a snapshot of conditions to park managers as well as information on short-term variability and seasonal trends of conditions in waters in the vicinity of Fort Pulaski (Objectives 1 and 2). The site monitored at Fort Pulaski (Table 1) is part of the SECN estuarine water-quality monitoring program, which collects data in the vicinity of seven coastal parks located along the southeastern U.S. coast described by DeVivo et al. (2008).

Fort Pulaski National Monument

Fort Pulaski National Monument is near the mouth of the Savannah River Estuary in Georgia (Figure 1). The Monument is composed of a series of small islands surrounded by salty, tidally influenced river channels and creeks. The primary habitats of the Monument are maritime forest, intertidal salt marsh, and the main channel of the estuary with its associated tidal creeks. Although there are no major sources of pollutants at Fort Pulaski itself, both point and nonpoint sources of pollutants can be found nearby that have the potential to affect its water resources. Wastewater treatment plants and pulp and paper mills are the primary point sources of organic

matter and nutrient loading in the lower Savannah River watershed. Numerous industries (including 20 Superfund sites) release contaminants to the groundwater, soil, or air, and there are also contaminants associated with dredge spoil sites. In addition, two major nuclear facilities and the Port of Savannah are located upstream of the Fort Pulaski study area (McFarlin and Alber 2005).

There have been numerous alterations to the Savannah River that have likely affected water-quality conditions at Fort Pulaski, including deepening and widening of the channel for navigation and the operation of tide gates and upstream dams. Efforts by state and federal agencies to further deepen the channel are currently underway. The Savannah Harbor Expansion Project would involve deepening 35 miles of the navigation channel an additional 6 to 8 feet and widening bends at 12 locations. Concerns associated with the deepening include its effects on water conditions (i.e., salinity, dissolved oxygen, water clarity, contaminant concentrations), and how those in turn might affect freshwater wetlands and aquatic resources (e.g., striped bass, shortnose sturgeon). Ongoing population growth and accompanying development in the area is also a concern, as it could alter the amount and quality of overland runoff.

Recent studies have indicated that nutrient concentrations generally decrease along the longitudinal gradient of the estuary as river water becomes increasingly diluted by salt water from the ocean. Sample data summarized by the National Coastal Assessment program (USEPA 2005) indicated that 63% of the dissolved inorganic nitrogen observations were *good* and 37% were *fair* (none were *poor*). In terms of phosphate, 93% of the observations were considered *fair*; 5% were *good*, and 2% were *poor*. These conclusions are based on very limited observations, as only 2–4 stations were sampled each year in the tidal creeks and estuary associated with Fort Pulaski, on a one-time basis only. A two-year effort by USGS (between 2002 and 2003), at which two stations adjacent to the park were sampled regularly, yielded higher proportions of nutrients considered *fair* or *poor*. In 2007, a study conducted by the Southeast Coast Network (SECN) collected data from 30 sites around the park and found generally *good* water-clarity conditions and *good* to *fair* dissolved oxygen conditions. Metal concentrations in benthic sediments were slightly elevated around Fort Pulaski; however, only levels of arsenic and nickel were elevated to levels deemed *fair* by the USEPA at 10 of the 30 sites. Total PCB concentration was slightly elevated at a single site in the South Channel of the Savannah River (Gregory et al. 2010). Nutrient concentrations were not assessed as part of this study. A coastal assessment (synoptic survey) was performed at Fort Pulaski in July, 2014, but at the time of publication of this report results were still pending.

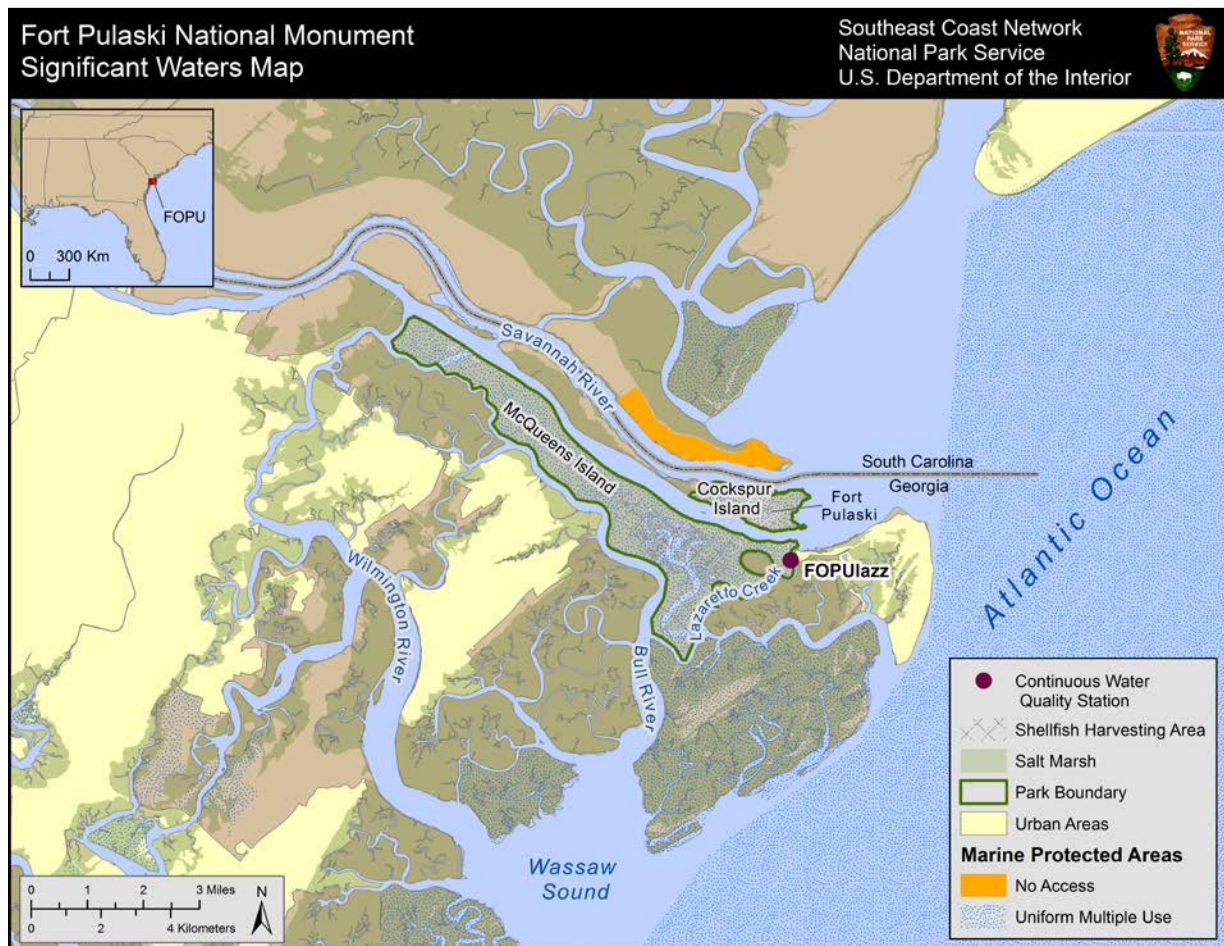


Figure 1. Map showing estuarine and marine water resources at Fort Pulaski National Monument in Georgia. Depicted are areas of salt marsh (U.S. Fish and Wildlife Service 2013), urbanization (United States Census Bureau 2013), 303(d) listed water bodies (United States Environmental Protection Agency 2013), and areas designated as having special uses or restrictions (National Oceanic and Atmospheric Administration 2013).

Methods

Data collection at the Fort Pulaski station is modeled after an ongoing water-quality monitoring program established by the National Estuarine Research Reserve Program (Wenner and Geist 2001). Detailed field and lab standard operating procedures and methods have been reported for the continuously-collected data in Gregory et al. (2013). Methods for both are briefly summarized in the following sections.

Sampling Locations

The Fort Pulaski station (FOPUlazz) is located on the south side of the fishing pier on Lazaretto Creek. The dock is popular with locals and tourist year-round. The station is located at Fort Pulaski National Monument roughly one mile east of the visitor center entrance. The site was selected because it is the only structure at the park to which the station housing could be mounted. Lazaretto Creek is a tidal creek that drains a large area of salt marsh into the Savannah River near the Atlantic Ocean.

Table 1. Name, location and period of record of continuous water-quality monitoring site at Fort Pulaski National Monument during 2006-2009.

Name	Location Description	Location (Lat /Long)	Period of Record
FOPUlazz	Lazaretto Creek Fishing Dock	32.014137 / -80.88412	8/14/2006 to present



Figure 2. Continuous data collection platform on Lazaretto Creek near Fort Pulaski National Monument 2006-2009. Photo by SECN staff.

Continuous Data

Continuously-collected data includes dissolved oxygen, salinity, pH, specific conductance, water temperature, depth and turbidity. Readings for these parameters are collected at 30-minute intervals using YSI data sondes (Model 6600) which are deployed in three- to five-week intervals depending on routine instrument maintenance schedules. The data collection platform consists of a 4" diameter PVC tube attached vertically to the handrail with the sonde suspended within and approximately 1 m from the bottom (Figure 2). Water is allowed to freely circulate via openings cut into the PVC housing. A carriage bolt is inserted through the housing at the submerged end to prevent instrument loss should the attachment hardware fail. Anti-fouling

paint is used on the PVC tube to extend deployment intervals which are sometimes shortened due to excessive biofouling. The sonde guard is covered with plastic mesh to prevent fish, crabs, and detritus from entering which could skew measurements or damage the instrument's probes. Figure 2 shows a photo of the station used 2006-2009 (The sonde mount is currently attached to an adjacent piling). Additional details on site selection and sonde mount installation procedures are reported in Gregory et al. (2013).

Prior to deployment, the data sonde is calibrated according to YSI recommendations for pH, dissolved oxygen, specific conductance, depth and turbidity (YSI Incorporated 2011), with additional instructions provided by Gregory et al. (2013). After instrument retrieval, data sondes are returned to the laboratory where post-deployment readings are made using calibration standards to evaluate the accuracy and validity of the data collected for that deployment period. All pre-deployment and post-retrieval calibration information is recorded on calibration data sheets that are archived at SECN office locations. After post-retrieval processing is complete, the sonde is cleaned, reconditioned, and readied for redeployment with methods outlined by YSI (2011). Performance specifications of the YSI 6600 are shown in Table 2.

Data generated during the deployment period are reviewed and certified by SECN staff prior to being made available to park staff. During the data review process data may be flagged (marked as suspect) for a variety of reasons including the presence of heavy fouling on equipment, lack of post-calibration data, readings outside of equipment specifications, calibration errors, and extended deployment times. All flagged data remain in the data set, but are excluded from all analyses and reports (tables, charts and graphs). Data may also be deleted from the data set on rare occasions such as probe failure or the sonde being out of the water during deployment. Days in which data collected is less than 75% of total expected data points do not have a daily mean calculated or reported in Figures 3-8.

Table 2. Performance specifications of YSI 6600 EDS data logger deployed at continuous monitoring site at Fort Pulaski National Monument (YSI 2011).

Parameter	Range	Resolution	Accuracy
Dissolved Oxygen (% saturation)	0–500%	0.1%	0 to 200%: +/- 2% of reading or 2% air saturation, whichever is greater
Dissolved Oxygen (mg/L)	0–50 mg/L	0.01 mg/L	0 to 20 mg/L: +/- 2% of reading or 0.2 mg/L whichever is greater
Conductivity	0–100 mS/cm	0.001 to 0.1 mS/cm; range dependent	+/- 0.5% of reading + 0.001 mS/cm
Temperature	-5–50 °C	0.01 °C	+/- 0.15°C
pH	0 to 14 units	0.01 units	+/- 0.2 unit
Depth	0–9 m (0–30 ft)	0.001m (0.001ft)	+/- 0.018m (+/- 0.06 ft)
Salinity	0–70 ppt	0.01 ppt	+/- 1% of reading or 0.1 ppt, whichever is greater
Turbidity	0–1,000 NTU	0.1 NTU	+/- 2% of reading or 0.3 NTU, whichever is greater

Discrete Data

Water sample collection for this project is conducted by SECN staff. Secchi depth is measured using a standard 8-in. diameter black-and-white Secchi disk. Water samples are collected as grabs in clean, acid washed, and field rinsed containers. Filtration is conducted using a 0.45-micron filter and samples are transported and shipped on ice. QA/QC field sampling includes

both field blanks and duplicates collected on random dates throughout the year. Filtered samples, and chlorophyll filters are placed on ice prior to shipment for lab analyses. Original chain of custody paperwork accompanies all samples to the laboratory. Data collection standard operating procedures are further documented in Gregory et al. (2013).

Water-clarity conditions were derived from estimated light attenuation coefficients (k) using the equation: $k = a / Z_{\text{Secchi}}$, where Z is Secchi depth, in meters and $a = 1.0$ (a is assigned to one of three values depending on the water bodies' naturally occurring clarity conditions i.e., $a = 1.0$ for naturally turbid conditions, $a = 1.4$ for moderately turbid conditions, or $a = 1.7$ for clear water estuaries). These constants were estimated for each water-clarity class based on values for Fort Pulaski that were reported in the literature (Smith et al. 2006). Although this method of estimating water-clarity condition is generally used when information on light transmission in the of the water column are missing, the SECN is reporting derived values for data consistency among other Network parks and recently collected datasets where water column light transmission information was not collected.

Assessment Criteria

Water quality was assessed for each of the parameters following the East/ Gulf Coast site criteria in the USEPA's National Coastal Assessment IV Report (Table 3) using data from the monthly samples (United States Environmental Protection Agency 2012). The categorical assessments (i.e., *good*, *fair*, and *poor*) use measurements of chlorophyll a , nutrients, dissolved oxygen and water clarity and are intended to highlight a range of conditions including acutely degraded water-quality conditions. Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are equivalent to the USEPA criteria for the assessed water bodies.

Table 3. Coastal water-quality monitoring condition criteria for water-quality parameters collected by the Southeast Coast Network. Based on thresholds set by USEPA (2012).

Rating	Water Clarity ¹ (k)	Chlorophyll a ($\mu\text{g/L}$)	Dissolved Inorganic Nitrogen (DIN) (mg/L)	Dissolved Inorganic Phosphorus (DIP) (mg/L)	Dissolved Oxygen (mg/L)
Good	<2.3	<5	<0.1	<0.01	>5
Fair	2.30–2.99	5–20	0.1–0.5	0.01–0.05	2–5
Poor	>2.99	>20	>0.5	>0.05	<2

¹ Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the USEPA (2012) criteria for the assessed water bodies.

Results

Continuous data variables were collected at 30-minute intervals for the date range of August 2006 through December 31, 2009. All parameters vary seasonally, diurnally, and/or with tidal cycles and weather events. Water temperature at Fort Pulaski National Monument ranged from a low of 7.5°C in January of 2009 to a high of 32.3° C in August, 2007. Mean monthly water temperatures ranged from 11.5°C in January, 2008 to 30.0°C in August, 2007. Salinity ranged from 9.12 ppt in April, 2009 to a high of 35.99 ppt in August, 2008. Monthly means ranged from 19.5 ppt in April, 2009 to 27.6 ppt in May, 2008. Individual readings for dissolved oxygen ranged from 2.33 mg/L in September, 2009 to a high of 11.73 mg/L in August, 2008. Monthly means ranged from 4.7 mg/L in August, 2007, to 9.1 mg/L in February 2007 and February 2009. Individual pH readings ranged from 7.11 in August 2009 to 8.37 in November of 2008. Monthly means for pH ranged from 7.5 in August and September of 2009 to 8.1 in November and December of 2008. Turbidity readings ranged from 1.2 NTU in August of 2007 to a high of 993.1 NTU in July, 2009. Monthly means for turbidity range from 16.7 in September, 2009 to 128.4 NTU in August of 2008. Tidal range at this site as measured by water depth varied approximately 4 meters across the period of record.

Continuous Data

Figures 3 through 8 depict the daily mean data for the entire data collection period by parameter. Relative water depth collected by SECN staff at the site (Figure 8) is included in this section as an aid to data interpretation because it includes information that shows daily tidal fluctuations. If the number of daily data points collected is not greater than 75% of total expected data points, daily means are not calculated or reported.

Minimum and maximum values for the month with the mean and standard deviation are provided in Table 4. The percentage of values field indicates the level of completeness of the monthly data sets used for calculating mean, maximum and minimum statistics, and equals the number of data points collected (i.e., not missing or flagged) divided by the total number of expected points for a complete month of data. For those months where all of the data were missing and/or flagged, the percentage of values is 0% and no statistics (mean, maximum or minimum) are presented. When the percentage of values is low, the statistics (mean, maximum and minimum) may be less accurate than months where all data were used in the calculation of summary statistics.

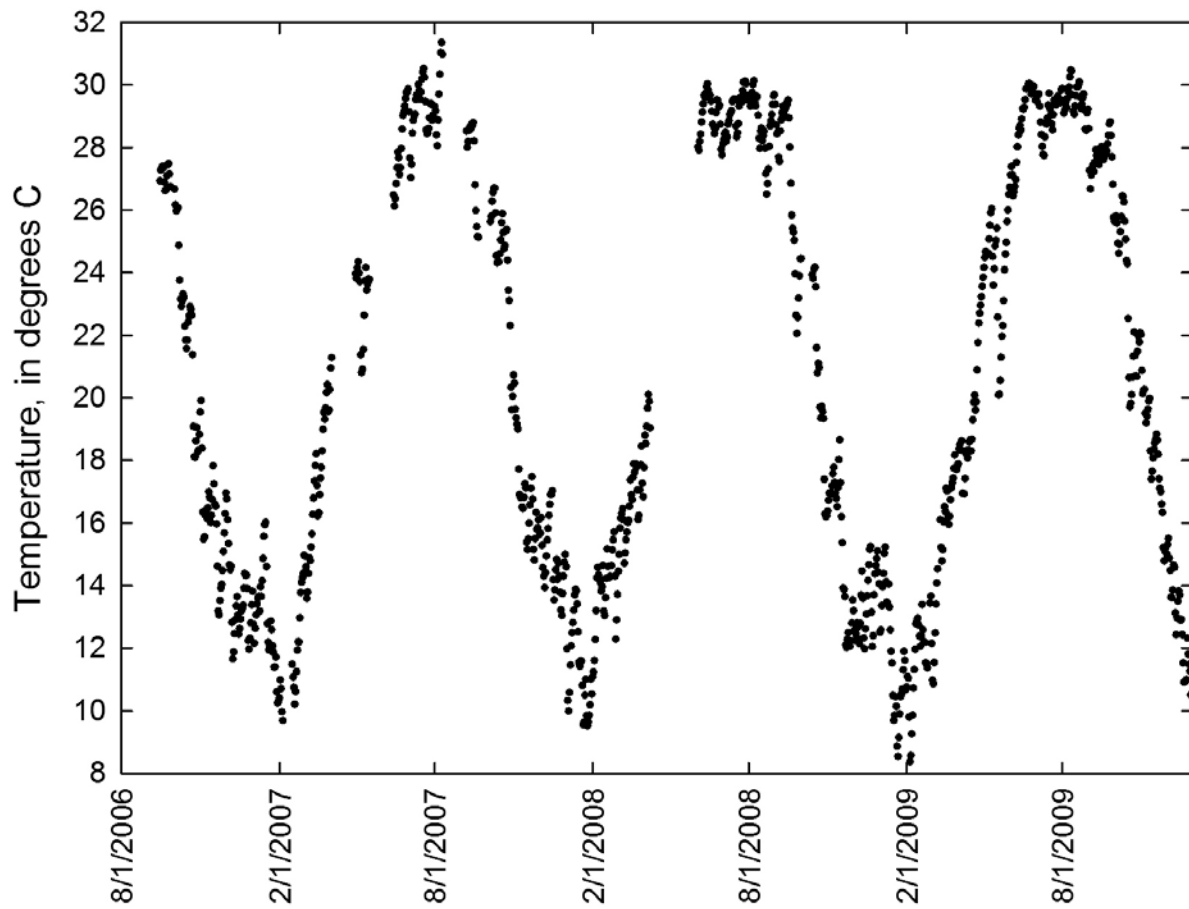


Figure 3. Mean daily water temperature on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Breaks in data record indicate missing and/or flagged data.

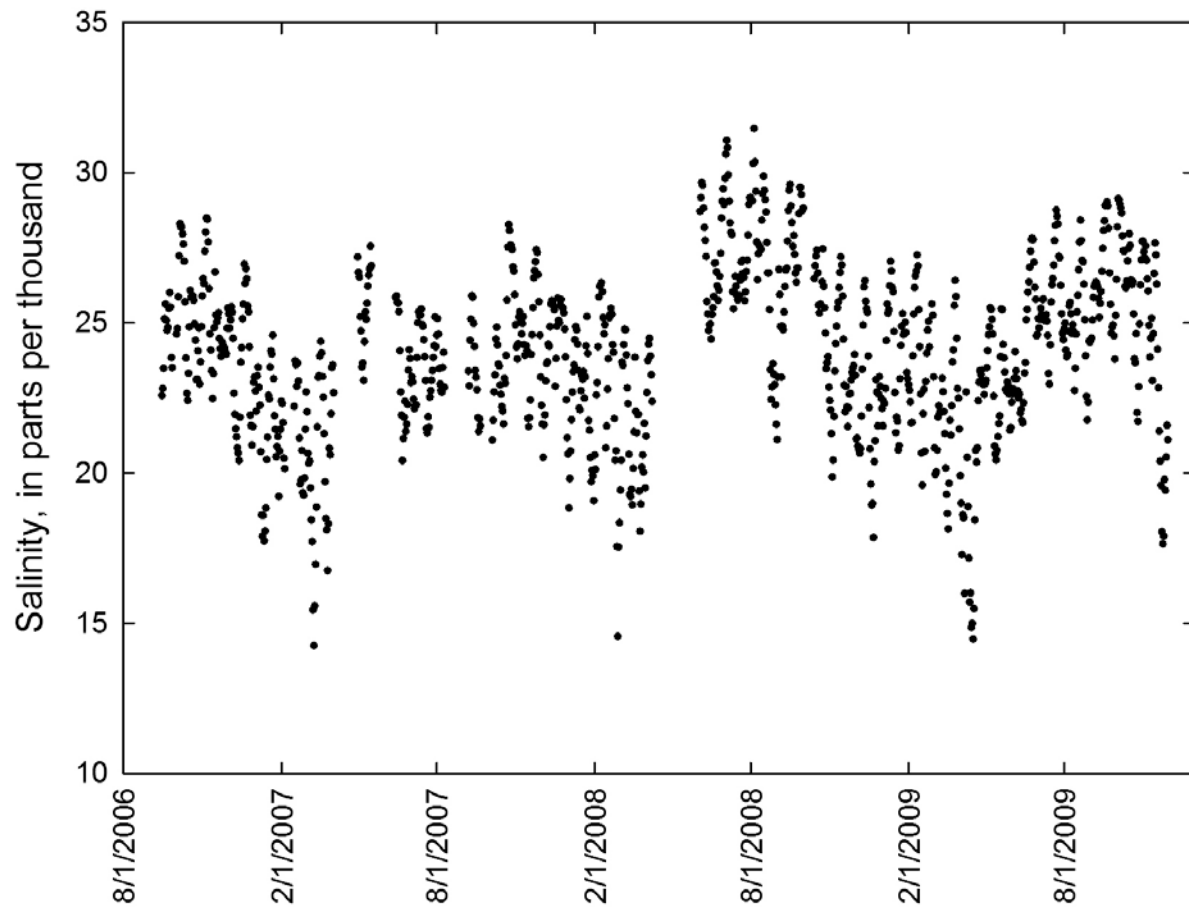


Figure 4. Mean daily salinity on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Breaks in data record indicate missing and/or flagged data

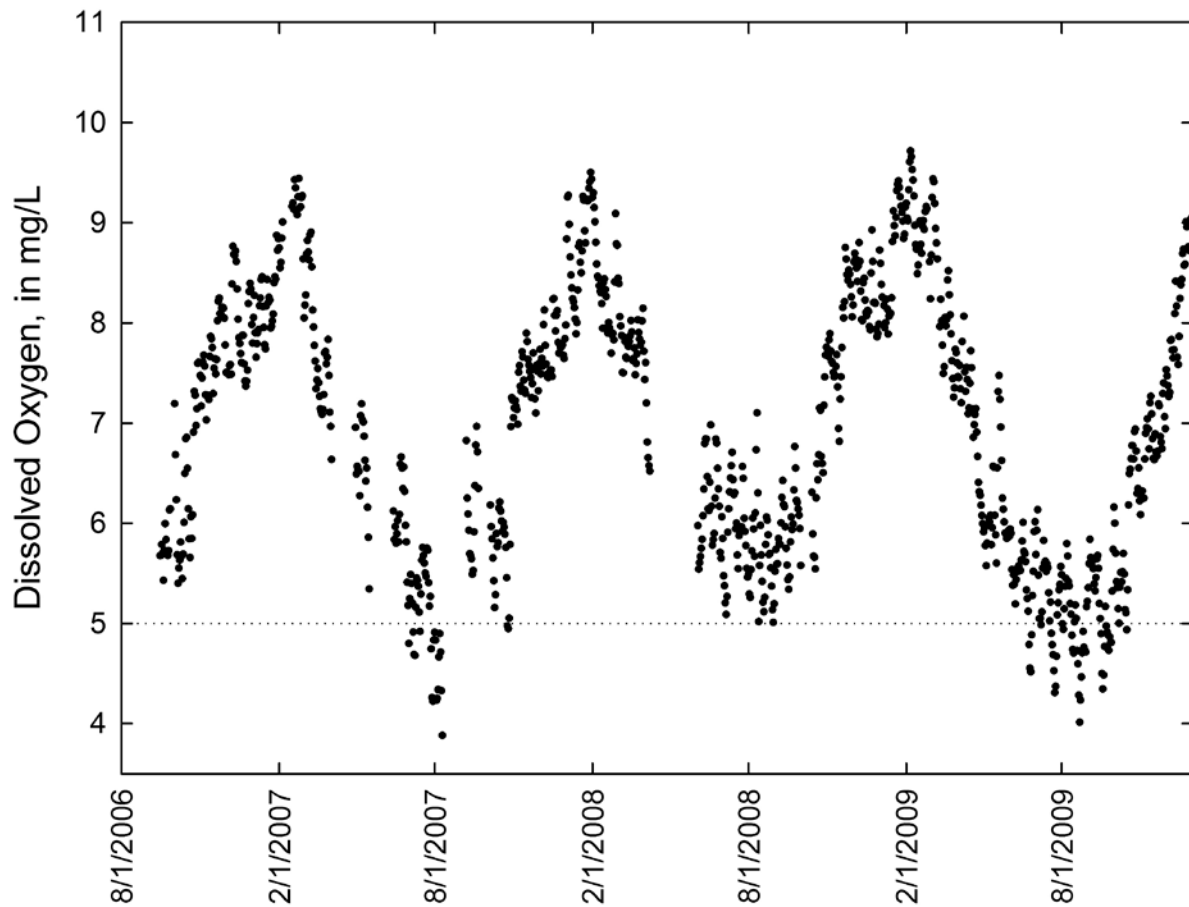


Figure 5. Mean daily dissolved oxygen on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Concentrations above 5 mg/L are considered “good” and those between 2 and 5 mg/l are considered “fair” based on EPA National Coastal Assessment Criteria. Breaks in data record indicate missing and/or flagged data.

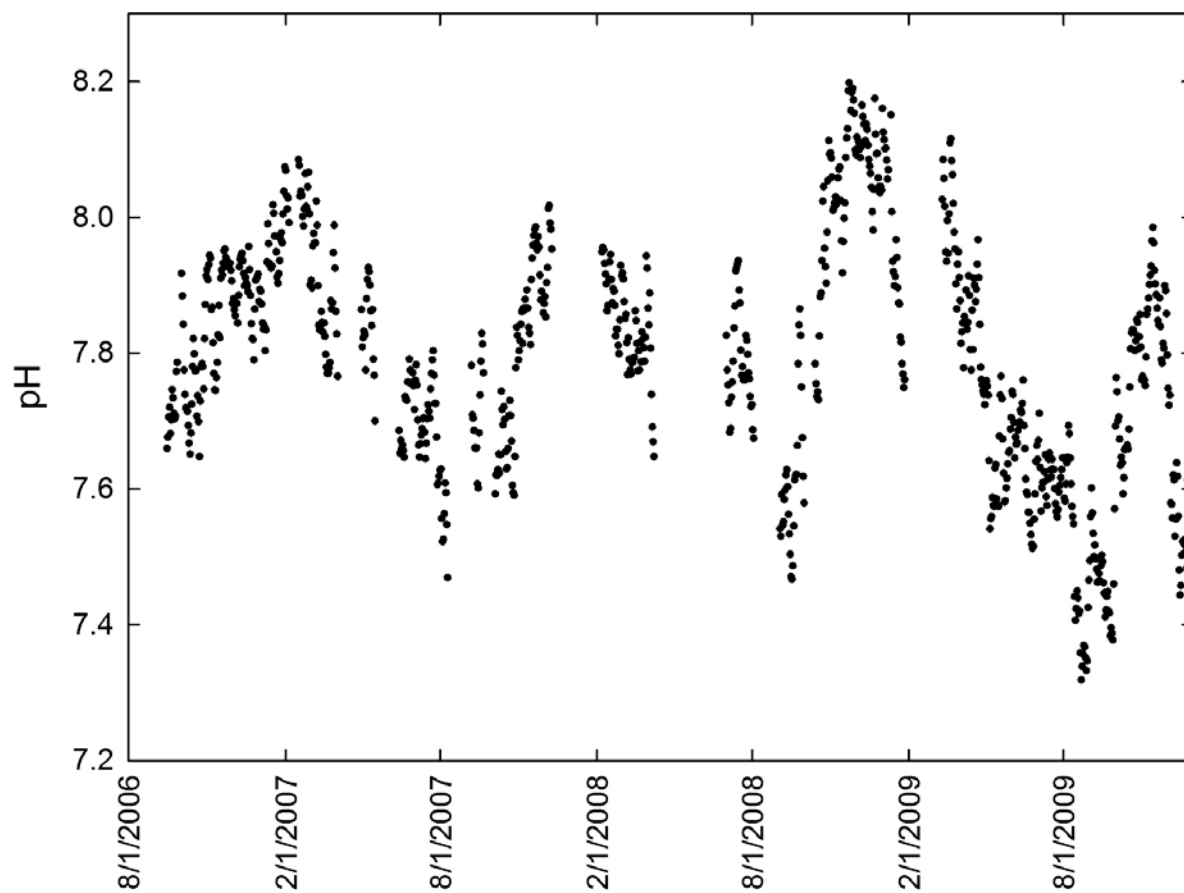


Figure 6. Mean daily pH on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Breaks in data record indicate missing and/or flagged data.

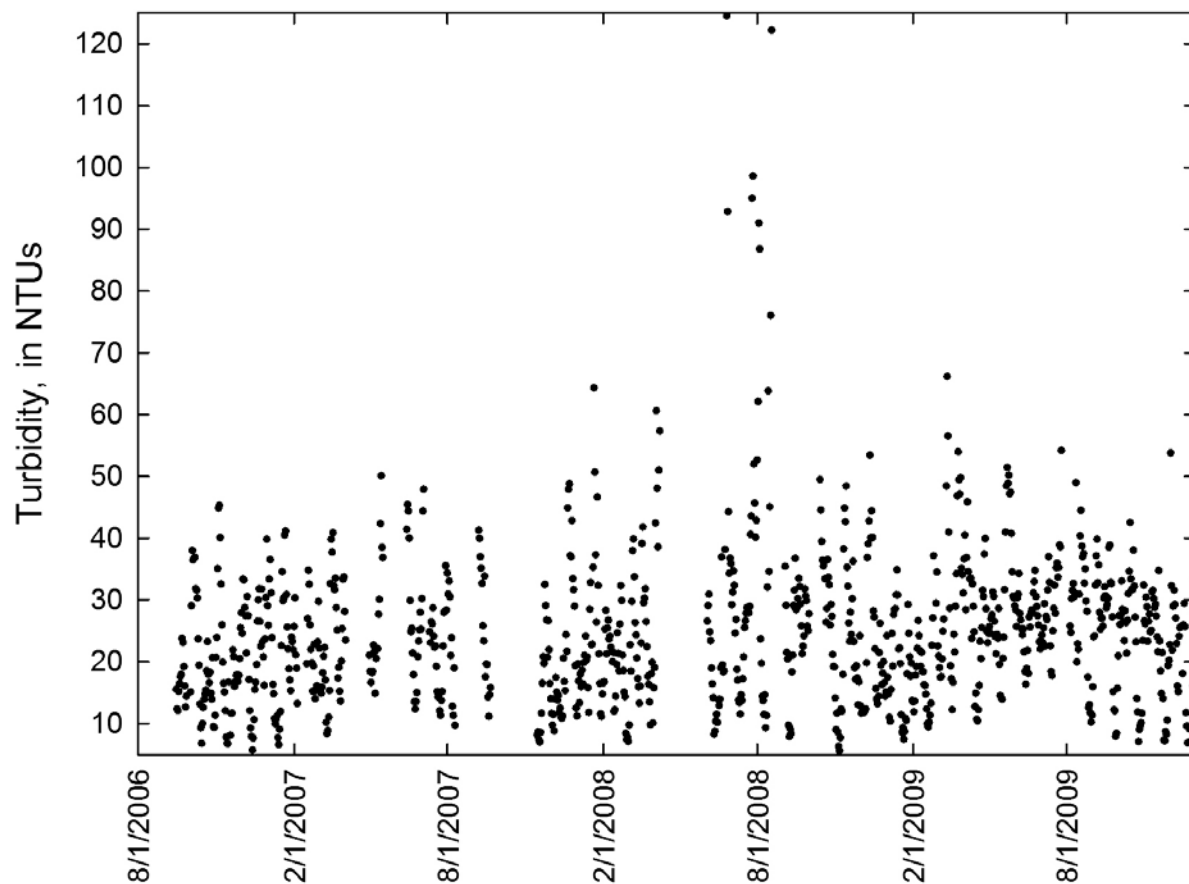


Figure 7. Mean daily turbidity, in NTUs, on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Breaks in data record indicate missing and/or flagged data.

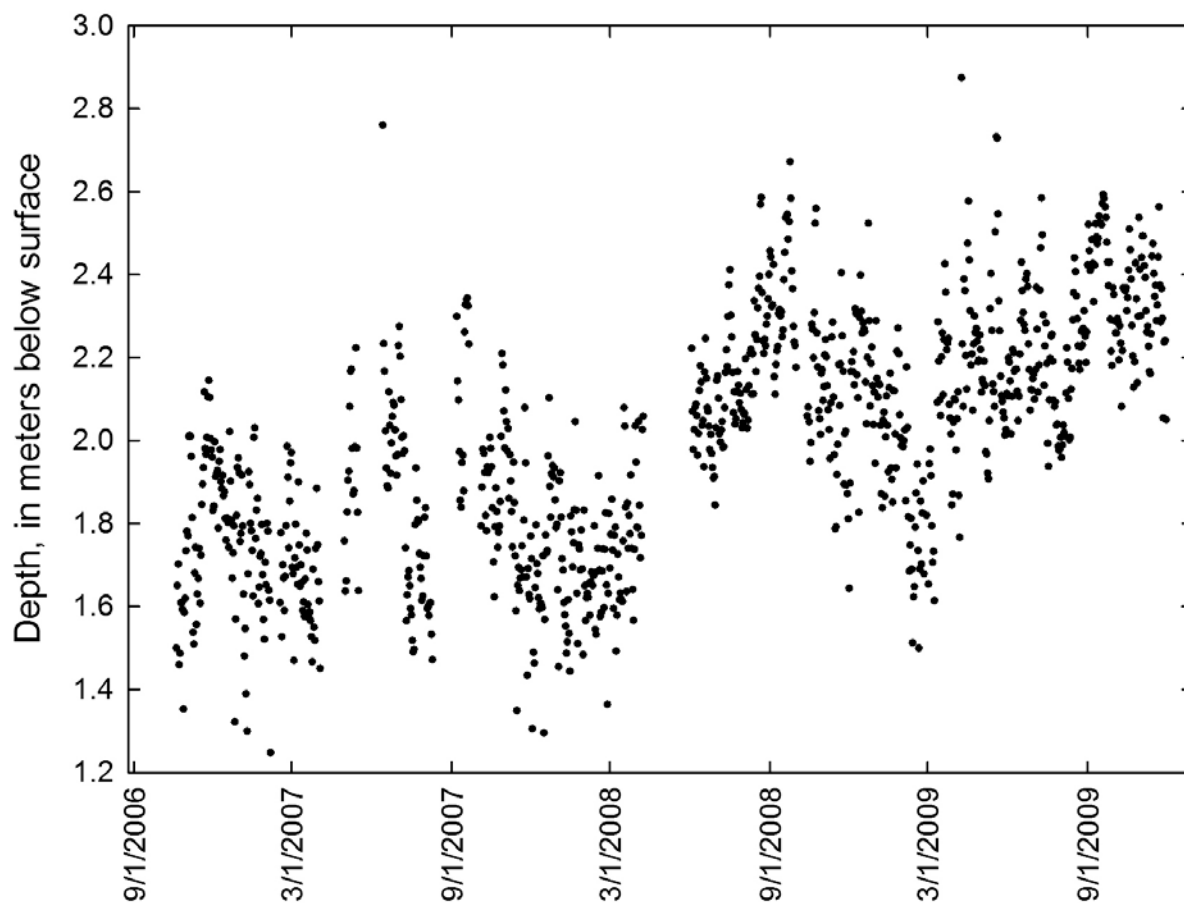


Figure 8. Mean daily depth on Lazaretto Creek near Fort Pulaski National Monument during 2006-2009. Breaks in data record indicate missing and/or flagged data.

Table 4. Monthly minimum, maximum and mean values for parameters collected by the YSI 6-series data sonde at Fort Pulaski National Monument in 2006-2009. Standard deviation (stdev) of the mean values are provided in parentheses. Percentage of values for each month indicates the number data points collected during one calendar month of data collection / total number of expected points for a complete month of data.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
August 2006 (Expected Count 1,488; no data collected)						
September 2006 (Expected Count 1,440)						
Actual Count	614	614	614	0	614	613
Minimum	26.11	17.730	4.33		7.48	5.10
Mean (stdev)	27.1 (0.4)	24.5 (3.0)	5.8 (0.6)		7.71 (0.16)	16.7 (12.0)
Maximum	28.05	31.60	7.52		8.10	147.30
Percentage	43%	43%	43%	0%	43%	43%
October 2006 (Expected Count 1,488)						
Actual Count	1,418	1,418	1,418	601	1,418	1,416
Minimum	17.18	18.560	4.25	0.365	7.45	3.40
Mean (stdev)	22.1 (2.6)	25.3 (3.0)	6.4 (0.8)	1.6 (0.7)	7.76 (0.15)	20.0 (16.2)
Maximum	26.89	31.25	8.34	2.74	8.14	192.20
Percentage	95%	95%	95%	40%	95%	95%
November 2006 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,439
Minimum	12.05	18.660	6.06	0.318	7.62	2.90
Mean (stdev)	16.0 (1.7)	25.2 (3.0)	7.7 (0.4)	1.9 (0.7)	7.88 (0.11)	20.0 (15.6)
Maximum	20.36	31.96	8.56	3.49	8.13	149.00
Percentage	100%	100%	100%	100%	100%	100%
December 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,487
Minimum	11.00	15.180	6.60	0.230	7.70	2.50
Mean (stdev)	13.6 (1.4)	23.7 (3.3)	7.9 (0.5)	1.8 (0.7)	7.89 (0.10)	22.6 (17.0)
Maximum	18.13	30.78	9.11	3.40	8.08	184.50
Percentage	100%	100%	100%	100%	100%	100%
January 2007 (Expected Count 1,488)						
Actual Count	1,485	1,485	1,486	1,484	1,485	1,484
Minimum	9.32	12.980	7.08	0.103	7.70	3.40
Mean (stdev)	12.9 (1.5)	21.4 (3.7)	8.2 (0.4)	1.7 (0.7)	7.93 (0.11)	22.2 (15.9)
Maximum	16.66	29.89	9.22	3.32	8.22	98.30
Percentage	100%	100%	100%	100%	100%	100%
February 2007 (Expected Count 1,344)						
Actual Count	849	849	849	849	849	846
Minimum	9.48	12.820	7.98	0.100	7.86	4.80
Mean (stdev)	11.7 (1.4)	21.5 (3.7)	9.1 (0.4)	1.7 (0.8)	8.04 (0.09)	22.0 (14.8)
Maximum	14.94	29.09	10.00	3.22	8.21	187.10
Percentage	63%	63%	63%	63%	63%	63%

Table 4. Continued.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
March 2007 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,453
Minimum	12.70	11.000	6.27	0.033	7.61	5.70
Mean (stdev)	16.9 (2.1)	20.2 (4.1)	7.9 (0.7)	1.7 (0.7)	7.88 (0.13)	22.6 (15.7)
Maximum	21.48	30.07	10.09	3.18	8.17	167.90
Percentage	100%	100%	100%	100%	100%	98%
April 2007 (Expected Count 1,440)						
Actual Count	1,435	1,435	1,435	1,429	1,435	1,429
Minimum	16.01	15.620	5.61	0.008	7.56	5.60
Mean (stdev)	19.8 (1.9)	23.9 (3.6)	7.4 (0.6)	1.7 (0.7)	7.88 (0.13)	23.6 (16.7)
Maximum	24.12	32.26	9.22	3.42	8.17	191.40
Percentage	100%	100%	100%	99%	100%	99%
May 2007 (Expected Count 1,488)						
Actual Count	790	790	790	790	790	790
Minimum	20.10	20.030	4.54	0.247	7.54	6.40
Mean (stdev)	23.1 (1.3)	25.5 (2.7)	6.6 (0.7)	1.9 (0.7)	7.84 (0.12)	25.9 (17.8)
Maximum	25.31	32.27	8.21	3.48	8.09	155.60
Percentage	53%	53%	53%	53%	53%	53%
June 2007 (Expected Count 1,440)						
Actual Count	788	788	788	788	788	788
Minimum	25.63	16.500	3.76	0.730	7.45	6.80
Mean (stdev)	28.1 (1.3)	23.2 (3.3)	6.1 (0.7)	2.0 (0.7)	7.72 (0.15)	25.4 (18.1)
Maximum	30.61	31.64	8.08	3.72	8.10	127.20
Percentage	55%	55%	55%	55%	55%	55%
July 2007 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,229
Minimum	26.46	16.230	2.78	0.224	7.31	4.40
Mean (stdev)	29.2 (0.9)	23.5 (3.0)	5.2 (0.8)	1.8 (0.8)	7.71 (0.17)	24.3 (18.1)
Maximum	31.47	31.26	7.31	3.56	8.08	117.60
Percentage	100%	100%	100%	100%	100%	83%
August 2007 (Expected Count 1,488)						
Actual Count	584	584	584	584	584	583
Minimum	27.46	17.340	2.64	0.277	7.28	1.20
Mean (stdev)	30.0 (1.2)	24.2 (3.2)	4.7 (0.8)	1.7 (0.8)	7.56 (0.18)	24.7 (22.0)
Maximum	32.28	32.73	7.15	3.06	7.96	240.80
Percentage	39%	39%	39%	39%	39%	39%
September 2007 (Expected Count 1,440)						
Actual Count	655	655	655	655	655	655
Minimum	24.62	17.780	4.52	0.648	7.39	4.60
Mean (stdev)	27.7 (1.3)	23.6 (3.0)	6.1 (0.7)	2.1 (0.7)	7.71 (0.15)	25.4 (19.3)
Maximum	29.39	32.14	7.62	3.23	8.01	107.10
Percentage	45%	45%	45%	45%	45%	45%
October 2007 (Expected Count 1,488)						
Actual Count	1,278	1,278	1,278	1,278	1,278	0
Minimum	18.99	17.770	3.65	0.237	7.38	
Mean (stdev)	24.5 (1.9)	24.6 (3.2)	5.9 (0.8)	1.9 (0.7)	7.68 (0.16)	

Table 4. Continued.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
March 2007 (Expected Count 1,488)						
Maximum	27.32	32.92	7.59	3.51	8.04	
Percentage	86%	86%	86%	86%	86%	0%
November 2007 (Expected Count 1,440)						
Actual Count	1,439	1,439	1,439	1,439	1,439	791
Minimum	14.30	18.680	4.68	0.055	7.65	2.10
Mean (stdev)	17.0 (1.6)	24.7 (2.7)	7.4 (0.4)	1.8 (0.7)	7.89 (0.12)	17.3 (12.5)
Maximum	21.82	30.82	8.43	3.51	8.18	80.00
Percentage	100%	100%	100%	100%	100%	55%
December 2007 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	502	1,488
Minimum	12.47	16.680	5.53	0.203	7.75	3.20
Mean (stdev)	14.9 (1.1)	24.1 (3.1)	7.7 (0.4)	1.7 (0.7)	7.94 (0.10)	21.6 (16.9)
Maximum	17.90	31.42	8.59	3.42	8.17	123.70
Percentage	100%	100%	100%	100%	34%	100%
January 2008 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	0	1,488
Minimum	8.34	14.300	7.43	0.224		4.80
Mean (stdev)	11.5 (1.5)	22.3 (3.4)	8.8 (0.5)	1.7 (0.7)		23.8 (18.1)
Maximum	15.35	30.74	9.81	3.28		120.60
Percentage	100%	100%	100%	100%	0%	100%
February 2008 (Expected Count 1,392)						
Actual Count	1,390	1,390	1,390	1,390	1,126	1,389
Minimum	10.61	11.270	6.79	0.156	7.69	3.20
Mean (stdev)	13.8 (1.3)	23.0 (4.2)	8.4 (0.5)	1.7 (0.7)	7.89 (0.10)	20.3 (16.6)
Maximum	16.61	31.25	9.59	2.99	8.12	191.50
Percentage	100%	100%	100%	100%	81%	100%
March 2008 (Expected Count 1,488)						
Actual Count	1,484	1,484	1,484	1,484	1,484	1,484
Minimum	12.89	12.210	6.64	0.022	7.61	3.70
Mean (stdev)	16.4 (1.2)	21.2 (3.7)	7.9 (0.4)	1.8 (0.7)	7.83 (0.11)	22.2 (15.9)
Maximum	19.48	30.22	9.56	3.12	8.07	107.60
Percentage	100%	100%	100%	100%	100%	100%
April 2008 (Expected Count 1,440)						
Actual Count	1,439	1,439	1,439	1,439	1,439	1,438
Minimum	16.66	14.370	5.00	0.219	7.41	5.40
Mean (stdev)	20.0 (1.4)	23.3 (3.3)	6.9 (0.5)	1.8 (0.7)	7.77 (0.14)	29.5 (21.2)
Maximum	23.80	32.81	8.39	3.54	8.16	169.10
Percentage	100%	100%	100%	100%	100%	100%
May 2008 (Expected Count 1,488)						
Actual Count	217	217	217	217	217	213
Minimum	20.36	21.040	4.77	0.221	7.45	26.00
Mean (stdev)	22.5 (0.9)	27.6 (2.5)	6.5 (0.8)	1.8 (0.8)	7.77 (0.17)	57.5 (21.9)
Maximum	24.23	32.41	8.08	3.28	8.07	187.40
Percentage	15%	15%	15%	15%	15%	14%

Table 4. Continued.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
March 2007 (Expected Count 1,488)						
June 2008 (Expected Count 1,440)						
Actual Count	1,321	1,321	1,321	1,321	0	1,283
Minimum	27.02	19.610	4.26	0.475		1.20
Mean (stdev)	29.1 (0.7)	26.9 (3.2)	6.2 (0.9)	2.0 (0.7)		31.0 (48.2)
Maximum	30.75	33.49	10.36	3.67		541.00
Percentage	92%	92%	92%	92%	0%	89%
July 2008 (Expected Count 1,488)						
Actual Count	1,487	1,487	1,487	1,487	1,450	1,472
Minimum	27.16	20.820	3.91	0.537	7.46	5.10
Mean (stdev)	29.1 (0.8)	27.5 (3.0)	5.9 (0.8)	2.1 (0.8)	7.80 (0.15)	32.0 (28.7)
Maximum	31.00	34.42	8.83	3.66	8.17	266.90
Percentage	100%	100%	100%	100%	97%	99%
August 2008 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	169	1,097
Minimum	26.09	17.120	3.50	0.580	7.48	4.70
Mean (stdev)	28.8 (1.0)	27.0 (3.6)	5.7 (0.9)	2.2 (0.8)	7.69 (0.14)	128.4 (218.7)
Maximum	30.89	35.99	11.73	3.68	7.97	991.60
Percentage	100%	100%	100%	100%	11%	74%
September 2008 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,362	1,389
Minimum	21.02	18.060	3.85	0.933	7.26	3.60
Mean (stdev)	27.0 (2.5)	26.9 (3.1)	5.9 (0.6)	2.4 (0.7)	7.61 (0.16)	36.2 (86.7)
Maximum	30.12	33.93	8.12	3.75	8.09	910.20
Percentage	100%	100%	100%	100%	95%	96%
October 2008 (Expected Count 1,488)						
Actual Count	867	867	867	867	867	867
Minimum	15.19	18.000	4.54	0.560	7.39	7.20
Mean (stdev)	20.5 (2.7)	25.7 (2.9)	6.6 (0.8)	2.2 (0.8)	7.90 (0.18)	31.3 (18.6)
Maximum	24.98	32.01	8.09	3.56	8.33	149.20
Percentage	58%	58%	58%	58%	58%	58%
November 2008 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,440
Minimum	10.96	17.380	6.15	0.318	7.78	1.50
Mean (stdev)	15.3 (2.2)	23.5 (3.0)	7.9 (0.6)	2.1 (0.7)	8.08 (0.12)	22.2 (18.2)
Maximum	19.56	31.86	9.06	3.59	8.37	162.40
Percentage	100%	100%	100%	100%	100%	100%
December 2008 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	11.26	12.950	7.19	0.146	7.81	4.40
Mean (stdev)	13.4 (1.1)	22.3 (3.6)	8.3 (0.4)	2.2 (0.7)	8.09 (0.11)	22.7 (17.1)
Maximum	16.28	31.35	9.28	4.00	8.33	159.70
Percentage	100%	100%	100%	100%	100%	100%
January 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,241	1,488

Table 4. Continued.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
March 2007 (Expected Count 1,488)						
Minimum	7.48	16.570	7.24	0.233	7.65	2.70
Mean (stdev)	11.8 (1.9)	23.9 (3.0)	8.7 (0.5)	2.0 (0.7)	7.96 (0.15)	19.1 (13.1)
Maximum	15.97	31.93	9.75	3.57	8.34	101.80
Percentage	100%	100%	100%	100%	83%	100%
February 2009 (Expected Count 1,344)						
Actual Count	1,225	1,225	1,225	1,225	0	1,225
Minimum	7.59	16.680	7.60	0.076		4.60
Mean (stdev)	11.5 (1.4)	23.8 (3.2)	9.1 (0.4)	1.8 (0.8)		18.1 (11.8)
Maximum	14.22	30.35	10.19	3.43		92.80
Percentage	91%	91%	91%	91%	0%	91%
March 2009 (Expected Count 1,488)						
Actual Count	1,416	1,416	1,416	1,403	994	1,416
Minimum	10.21	14.420	6.48	0.277	7.75	7.20
Mean (stdev)	15.4 (2.2)	22.2 (3.7)	8.2 (0.7)	2.0 (0.8)	8.00 (0.12)	32.5 (23.1)
Maximum	19.12	32.26	10.01	3.53	8.29	173.90
Percentage	95%	95%	95%	94%	67%	95%
April 2009 (Expected Count 1,440)						
Actual Count	1,333	1,333	1,333	1,333	1,333	1,332
Minimum	16.34	9.120	3.91	0.255	7.31	4.70
Mean (stdev)	19.6 (1.9)	19.5 (4.5)	7.1 (0.7)	2.2 (0.8)	7.84 (0.16)	27.1 (18.2)
Maximum	24.74	29.20	8.60	3.77	8.23	195.00
Percentage	93%	93%	93%	93%	93%	93%
May 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	19.46	14.380	3.71	0.642	7.39	7.10
Mean (stdev)	24.0 (1.8)	23.1 (3.4)	6.2 (0.7)	2.2 (0.8)	7.64 (0.13)	30.6 (19.3)
Maximum	28.65	31.42	7.79	3.63	8.08	139.70
Percentage	100%	100%	100%	100%	100%	100%
June 2009 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,439
Minimum	24.86	15.260	2.60	0.791	7.31	6.10
Mean (stdev)	28.7 (1.4)	24.3 (3.5)	5.4 (0.8)	2.2 (0.8)	7.64 (0.17)	26.5 (14.5)
Maximum	31.12	31.95	8.07	3.98	8.05	112.60
Percentage	100%	100%	100%	100%	100%	100%
July 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,387
Minimum	27.14	17.610	2.87	0.648	7.36	7.00
Mean (stdev)	29.1 (0.7)	25.8 (3.0)	5.3 (0.8)	2.2 (0.8)	7.62 (0.14)	67.1 (137.9)
Maximum	30.79	32.24	7.74	3.80	7.99	993.10
Percentage	100%	100%	100%	100%	100%	93%
August 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,343
Minimum	28.01	17.570	2.90	0.688	7.11	4.30
Mean (stdev)	29.5 (0.6)	25.0 (3.2)	5.0 (0.8)	2.2 (0.7)	7.48 (0.19)	48.3 (116.0)

Table 4. Continued.

	Temp °C	Salinity ppt	DO mg/L	Depth m	pH	Turbidity NTU
March 2007 (Expected Count 1,488)						
Maximum	31.46	33.16	7.85	3.84	7.94	948.70
Percentage	100%	100%	100%	100%	100%	90%
September 2009 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,440
Minimum	25.20	19.580	2.33	1.082	7.24	3.20
Mean (stdev)	27.7 (0.7)	26.3 (2.7)	5.2 (0.7)	2.5 (0.7)	7.47 (0.13)	26.6 (15.8)
Maximum	29.69	31.62	7.27	3.90	7.80	92.80
Percentage	100%	100%	100%	100%	100%	100%
October 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,485
Minimum	18.85	18.520	3.64	0.985	7.45	3.50
Mean (stdev)	23.3 (2.3)	26.4 (3.2)	5.9 (0.8)	2.3 (0.7)	7.74 (0.14)	24.8 (16.2)
Maximum	27.48	33.39	7.61	3.77	8.03	108.80
Percentage	100%	100%	100%	100%	100%	100%
November 2009 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,440
Minimum	13.76	12.920	4.42	0.828	7.59	3.80
Mean (stdev)	18.3 (1.8)	23.6 (4.6)	6.8 (0.5)	2.3 (0.7)	7.86 (0.13)	22.4 (14.4)
Maximum	22.73	33.20	7.75	3.77	8.25	127.00
Percentage	100%	100%	100%	100%	100%	100%
December 2009 (Expected Count 1,488)						
Actual Count	1,488	0	1,488	0	1,488	1,488
Minimum	9.86		6.68		7.17	3.10
Mean (stdev)	12.8 (1.6)		8.2 (0.6)		7.58 (0.19)	21.3 (17.5)
Maximum	16.10		9.43		8.21	176.40
Percentage	100%	0%	100%	0%	100%	100%

Discrete Data

Monthly water-quality data collected at the SECN site near Fort Pulaski National Monument during 2006-2009 are shown in Table 5 below. Thirty-eight months of discrete data samples were collected. Water clarity was *good* 76% of the time and *poor* 16% of the time, with *poor* readings occurring in the months of April through November in various years. Two sampling dates (5%) did not have water-clarity data. Dissolved oxygen was *good* 89% of the time, with 11% rating *fair*. *Fair* readings occurred in the summer months of May through August. The majority of chlorophyll *a* results (76%) were *fair*, 13% (five sampling dates) were missing, one result was *poor* (3%) in September 2007, and three results (8%) were *good*, with all *good* results happening in the month of December. Dissolved inorganic nitrogen and dissolved inorganic phosphorus samples were taken quarterly, with a total of ten sampling dates. Dissolved inorganic nitrogen was *good* 60% of the time and *fair* 40%, while dissolved inorganic phosphorus was *fair* 90% of the time and *poor* 10%.

Anomalies and Missing Data

The period of data collection presented in this report is August 14, 2006 at 14:00 through December 31, 2009 at 23:30. Missing or anomalous data during the reporting year may be due to several factors, including equipment malfunction, calibration errors, excessive biofouling, or periods of time when equipment is not deployed (such as during extreme storm events or routine equipment swaps). Anomalous data during 2006-2009 was most commonly associated with pH probe failure, temperature probe failure, calibration issues with depth, and turbidity spikes reading outside the limits of the sonde, and mount and equipment issues. No corrections were applied to data as per data analysis procedures prescribed in Gregory et al. (2013).

Table 5. Monthly water-quality data collected at the Southeast Coast Network site near Fort Pulaski National Monument during 2006-2009. Water clarity was assessed using light attenuation coefficient (*k*) using a constant for estuarine water with naturally turbid conditions (Smith et al. 2006) and assessment categories that correspond to USEPA (2012). Condition of other assessed parameters from USEPA (2012). [Green (■), *good*; yellow (■), *fair*; and red (■), *poor*; *k*, light attenuation coefficient; µg/L, micrograms per liter; mg/L, milligrams per liter; --, data missing or not collected; Chl *a*, chlorophyll *a*; DIN, dissolved inorganic nitrogen; DIP, dissolved inorganic phosphorus; DO, dissolved oxygen; TDN, total dissolved nitrogen; TDP, total dissolved phosphorus].

Date	Water Clarity (k)	Chl <i>a</i> (µg/L)	DIN (mg/L)	DIP (mg/L)	DO (mg/L)	TDN (mg/L)	TDP (mg/L)
11/16/2006	--	6.56	--	--	6.8	0.26	0.040
12/15/2006	0.80	4.61	--	--	7.9	0.42	0.037
1/9/2007	1.33	--	--	--	8.0	--	--
2/6/2007	1.00	--	--	--	11.5	--	--
03/06/2007	1.33	9.05	--	--	9.0	0.03	0.380
04/03/2007	1.67	10.62	--	--	7.1	0.44	0.032
05/01/2007	2.00	13.94	0.051	0.0117	6.1	0.28	0.029
06/14/2007	2.50	15.73	--	--	5.5	0.55	0.047
07/10/2007	2.00	12.12	--	--	4.7	0.45	0.044
08/10/2007	1.54	16.06	0.104	0.0329	4.8	0.39	0.050
09/07/2007	4.00	34.70	--	--	7.1	0.35	0.033
10/05/2007	4.00	5.18	--	--	6.2	0.50	0.054
11/14/2007	1.00	8.03	0.106	0.0308	7.4	0.33	0.045
12/11/2007	1.43	6.52	--	--	7.3	0.41	0.042
01/08/2008	1.43	5.81	--	--	8.1	0.00	0.000
02/06/2008	1.33	8.27	0.048	0.0208	8.3	0.32	0.037
03/04/2008	1.33	8.08	--	--	7.6	0.29	0.037
04/08/2008	4.00	14.50	--	--	6.2	0.35	0.037
05/05/2008	2.00	9.88	0.022	0.0202	4.8	0.36	0.040
06/03/2008	2.00	9.74	--	--	4.6	0.34	0.050
7/1/2008	1.33	--	--	--	6.8	--	--
08/04/2008	4.00	17.64	--	--	5.3	0.35	0.064
9/2/2008	--	--	--	--	5.4	--	--
10/1/2008	2.00	--	--	--	5.6	--	--
11/03/2008	2.00	8.13	0.182	0.0335	8.05	0.45	0.051
12/02/2008	1.33	3.73	--	--	8.8	0.39	0.051
01/09/2009	2.00	5.65	--	--	7.7	0.34	0.046
02/06/2009	1.00	6.68	0.078	0.0220	9.9	0.29	0.035
03/10/2009	2.00	12.96	--	--	8.8	0.00	0.000
04/07/2009	1.43	6.03	--	--	7.5	0.42	0.042
05/06/2009	2.00	7.75	0.079	0.0198	5.0	0.35	0.035
06/16/2009	1.33	15.19	--	--	5.8	0.44	0.068
07/07/2009	1.33	14.25	--	--	5.9	0.38	0.073
08/14/2009	2.00	12.76	0.282	0.0510	5.0	0.58	0.086
09/02/2009	1.33	13.10	--	--	6.1	0.45	0.074
10/01/2009	6.67	9.23	--	--	5.6	0.48	0.087
11/06/2009	5.00	7.04	0.086	0.0217	6.8	0.29	0.057
12/01/2009	1.33	3.41	--	--	7.3	0.46	0.055

Table 6. Description of anomalous and deleted data and associated periods of record for the data collection platform at on Lazaretto Creek near Fort Pulaski during 2006-2009.

Parameter Affected	Anomaly Description	Start Date	End Date
ALL	MISSING DATA	9/27/2006 7:00 PM	10/2/2006 10:30 AM
		1/9/2007 2:30 PM	1/9/2007 3:00 PM
		2/5/2007 4:30 AM	2/5/2007 4:30 AM
		2/5/2007 5:30 AM	2/5/2007 7:00 AM
		2/5/2007 8:00 AM	2/6/2007 2:00 PM
		2/15/2007 11:00 AM	2/15/2007 12:30 PM
		5/17/2007 11:00 AM	6/13/2007 11:30 PM
		6/14/2007 12:30 AM	6/14/2007 2:00 PM
		8/8/2007 12:00 AM	8/8/2007 12:00 AM
		9/7/2007 10:30 AM	9/7/2007 11:30 AM
		9/20/2007 12:00 AM	9/20/2007 12:00 AM
		9/20/2007 11:00 PM	9/20/2007 11:00 PM
		9/21/2007 12:00 AM	9/21/2007 12:00 AM
		9/21/2007 1:00 AM	9/21/2007 1:00 AM
		9/21/2007 2:00 AM	9/21/2007 2:00 AM
		9/21/2007 3:00 AM	9/21/2007 3:00 AM
		9/21/2007 4:00 AM	9/21/2007 4:00 AM
		9/21/2007 5:00 AM	9/21/2007 5:00 AM
		9/21/2007 6:00 AM	9/21/2007 6:30 AM
		9/21/2007 7:30 AM	9/21/2007 7:30 AM
		9/21/2007 8:30 AM	9/21/2007 8:30 AM
		9/21/2007 9:30 AM	10/4/2007 11:30 PM
		10/5/2007 12:30 AM	10/5/2007 9:00 AM
		11/14/2007 12:00 PM	11/14/2007 12:00 PM
		2/6/2008 12:00 PM	2/6/2008 12:30 PM
		4/6/2008 12:00 AM	4/6/2008 12:00 AM
		5/5/2008 12:00 AM	5/5/2008 12:00 AM
		5/5/2008 1:00 PM	6/2/2008 11:30 PM
		6/3/2008 12:30 AM	6/3/2008 11:30 AM
		7/1/2008 12:00 AM	7/1/2008 12:00 AM
		10/1/2008 1:30 PM	10/14/2008 11:30 AM
		2/25/2009 6:00 PM	2/28/2009 5:00 AM
		3/9/2009 5:30 PM	3/9/2009 5:30 PM
		3/9/2009 6:30 PM	3/9/2009 7:00 PM
		3/9/2009 8:00 PM	3/10/2009 10:00 AM
		4/7/2009 10:30 AM	4/9/2009 3:30 PM

Table 6. Continued.

Parameter Affected	Anomaly Description	Start Date	End Date
All	Data marked suspect because no post calibration was performed and data quality cannot be verified	8/14/2006 14:00	9/14/2006 23:30
		2/6/2007 14:30	2/15/2007 10:30
	Data was deleted due to a temperature probe failure. All parameters have to be deleted because they are temperature dependent	8/12/2007 0:00	8/12/2007 0:00
		8/12/2007 12:30	8/14/2007 4:00
		8/14/2007 21:00	9/7/2007 10:00
	Data was deleted due to unknown sonde malfunction	3/10/2009 11:00	3/11/2009 6:30
	Data was deleted due to YSI 6600 data sonde being out of water. The salinity and dissolved oxygen readings indicated that the sonde was out of water	4/16/2007 0:00	4/16/2007 2:00
		3/8/2008 14:00	3/8/2008 15:30
Depth	Data is marked suspect due to a calibration error	9/15/2006 0:00	9/27/2006 18:15
		10/2/2006 11:00	10/19/2006 10:45
	Data is marked suspect due to mount / equipment issues	12/1/2009 0:00	12/31/2009 23:15
	Data is suspect due to an unknown sonde malfunction	3/1/2009 14:00	3/1/2009 19:45
		1/9/2007 14:00	1/9/2007 13:45
	Depth readings were negative or zero	4/15/2007 13:00	4/15/2007 13:15
		4/16/2007 13:00	4/16/2007 13:45
		4/17/2007 2:00	4/17/2007 1:45
pH		12/11/2007 0:00	12/11/2007 0:00
	Data is marked suspect due to a calibration error	12/11/2007 11:30	12/31/2007 23:30
		8/4/2008 12:30	9/2/2008 14:30
		1/9/2009 12:30	1/10/2009 22:30
		1/1/2008 0:00	2/6/2008 11:30
		6/3/2008 0:00	6/3/2008 0:00
	pH data was deleted due to probe failure during the deployment	6/3/2008 12:00	6/30/2008 23:30
		7/1/2008 0:30	7/1/2008 18:30
		1/28/2009 7:00	2/25/2009 17:30
		2/28/2009 5:30	3/9/2009 17:00

Table 6. Continued.

Parameter Affected	Anomaly Description	Start Date	End Date
pH	pH data was deleted due to probe failure during the deployment	3/9/2009 18:00	3/9/2009 18:00
		3/9/2009 19:30	3/9/2009 19:30
Salinity and Conductivity	Data is marked suspect due to mount / equipment issues	12/1/2009 0:00	12/31/2009 23:30
	Data is marked suspect due to mount / equipment issues	10/5/2007 0:00	10/5/2007 0:00
		10/5/2007 9:30	11/14/2007 11:30
	Intermittent Data is suspect due to an unknown sonde malfunction	3/6/2007 22:30	3/11/2007 12:00
		1/15/2007 5:30	1/15/2007 5:30
		2/16/2007 21:30	2/16/2007 21:30
		2/20/2007 13:30	2/20/2007 13:30
		2/20/2007 23:30	2/20/2007 23:30
		3/17/2007 9:00	3/17/2007 9:00
		3/18/2007 9:30	3/18/2007 9:30
	Data is suspect due to an unknown sonde malfunction	3/19/2007 21:30	3/19/2007 21:30
		4/12/2007 2:30	4/12/2007 2:30
Turbidity		4/14/2007 9:00	4/14/2007 9:00
		4/16/2007 4:00	4/16/2007 4:00
		4/16/2007 22:30	4/16/2007 22:30
		4/18/2007 11:30	4/18/2007 11:30
		4/18/2007 19:30	4/18/2007 19:30
		8/9/2007 2:30	8/9/2007 2:30
		6/24/2008 21:30	6/28/2008 12:00
		7/25/2008 14:30	7/27/2008 19:30
	Intermittent Turbidity data marked suspect due to lone spike, less than 1,000 but more than 200 from previous and following readings	8/15/2008 6:30	8/27/2008 19:00
		7/27/2009 20:30	8/1/2009 20:30
	Turbidity data marked suspect due to lone spike, less than 1,000 but more than 200 from previous and following readings	9/24/2006 2:30	9/24/2006 2:30

Table 6. Continued.

Parameter Affected	Anomaly Description	Start Date	End Date
Turbidity	Turbidity data marked suspect due to lone spike, less than 1,000 but more than 200 from previous and following readings	11/21/2006 14:30	11/21/2006 14:30
		12/10/2006 8:00	12/10/2006 8:00
		2/15/2008 15:00	2/15/2008 15:00
		4/6/2008 5:00	4/6/2008 5:00
		5/3/2008 3:30	5/3/2008 3:30
		5/3/2008 23:00	5/3/2008 23:00
		5/4/2008 3:30	5/4/2008 3:30
		5/5/2008 11:00	5/5/2008 11:00
		6/18/2008 18:30	6/18/2008 18:30
		6/20/2008 22:30	6/20/2008 22:30
		6/20/2008 23:30	6/20/2008 23:30
		7/1/2008 7:30	7/1/2008 7:30
		8/1/2008 19:00	8/1/2008 19:00
		8/3/2008 0:00	8/3/2008 0:00
		8/3/2008 15:00	8/3/2008 15:00
		4/18/2009 9:00	4/18/2009 9:00
		8/3/2009 20:00	8/3/2009 20:00
		8/10/2009 21:30	8/10/2009 21:30
		10/15/2009 22:30	10/15/2009 22:30
		10/18/2009 11:30	10/18/2009 11:30
		10/19/2009 5:00	10/19/2009 5:00
	Intermittent turbidity data marked suspect due to spikes of 1000 NTU or higher. Spiking turbidity data could be a result of direct interference from a foreign body and/or the EDS wiper parking over the optics	8/18/2008 23:30	9/2/2008 14:30
		7/28/2009 0:30	8/4/2009 21:00
	Turbidity data marked suspect due to spikes of 1000 NTU or higher. Spiking turbidity data could be a result of direct interference from a foreign body and/or the EDS wiper parking over the optics	10/8/2006 2:30	10/8/2006 2:30
		10/18/2006 1:00	10/18/2006 1:00
		6/25/2008 2:00	6/25/2008 2:00
		6/25/2008 19:00	6/25/2008 19:00

Table 6. Continued.

Parameter Affected	Anomaly Description	Start Date	End Date
Turbidity	Turbidity data marked suspect due to spikes of 1000 NTU or higher. Spiking turbidity data could be a result of direct interference from a foreign body and/or the EDS wiper parking over the optics	6/26/2008 1:00	6/26/2008 1:00
		6/26/2008 2:00	6/26/2008 2:00
		6/26/2008 6:00	6/26/2008 6:00
		6/26/2008 10:30	6/26/2008 10:30
		6/26/2008 13:00	6/26/2008 13:00
		6/27/2008 0:00	6/27/2008 0:00
		6/27/2008 23:00	6/27/2008 23:00
		7/9/2008 13:00	7/9/2008 13:00
		7/20/2008 1:00	7/20/2008 1:00
		9/27/2008 12:00	9/27/2008 12:00
	Turbidity readings marked suspect due to heavy fouling on and around probes during deployment	6/6/2009 4:30	6/6/2009 4:30
		1/1/2007 0:00	1/1/2007 0:00
		7/5/2007 1:30	7/10/2007 10:30

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