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Boynton Inlet 48-hour Sampling Intensives, June and September, 2007

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Boynton Inlet, July 12, 2008.

Abstract

In 2007, the Florida Area Coastal Environment (FACE) program of the Ocean Chemistry Division of NOAA's Atlantic Oceanographic and Meteorological Laboratory performed two 48-hour intensive studies of the water flowing through the Boynton Inlet, Boynton Beach, Florida. Also partnering in this program were the Cooperative Institute for Marine and Atmospheric Sciences of the University of Miami, the Laboratories for Engineered Environmental Solutions, Florida Atlantic University, Boca Raton, Florida, and the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami.

Sampling was performed from the southern boardwalk (June Intensive) or from the Boynton Beach Inlet bridge (September Intensive, Figure 2). The sampling strategy was designed to collect water samples over two complete tidal cycles. The goal was to quantify the total flux of nearshore-source entities into coastal waters. The first sampling event was conducted between June 04-06, 2007; and the second between September 26-28 of 2007. Data collected include nutrients (Si, PO_4, NH_4, NO_3 + NO_2), isotope ratio analysis of nitrogen, the presence or absence of selected biological indicators (E. coli, Enterococci, and total coliform), as well as physical parameters including pH, salinity, total suspended solids (TSS), and turbidity. Critical to this study was the continuous in situ flow rate measurements obtained via an acoustic Doppler current profiler (ADCP) mounted on the north side of the inlet. This report presents the data from the Intensives.

The data reported herein suggest that inlets are important contributors of nutrient and microbiological loads to the coastal zone. The overall view presented is that the lagoon input into the Inlet may be substantial but is also highly variable.

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Rosenstiel School of Marine and Atmospheric Science (RSMAS) graduate student Courtney Dryer provided nitrogen isotope ratio analysis for water samples, Maribeth Gidley assisted in filtering efforts and David Wanless conducted all real-time PCR analysis.

We would also like to recognize the efforts of AOML staff; Dr Christopher Sinigalliano, for tirelessly filtering water samples on site, and providing methodology and summaries of microbiology results; Chuck Featherstone for coordinating the water sampling effort, and providing site sampling descriptions and methodology; Lt. Madeleine Adler for assisting with the water sampling; Charlie Fischer for conducting all nutrient analyses; Jack Stamates for providing all flow rate measurements and a description of ADCP methodology; and Cheryl Brown for compiling and presenting these data in a clear manner.

Introduction

The Boynton (South Lake Worth) Inlet was created in 1917 to improve tidal circulation and provide flushing to the south end of Lake Worth Lagoon [PBCDERM 1990]. It is the southernmost outlet for the Lake Worth Lagoon, which itself receives input from three canals (C-16, C-17, and C-51), several cities, and non-point pollution sources which may include septic tanks, polluted aquifers, landfills, injected treated wastewater, and agricultural chemicals. The inlet is approximately 200 feet wide and 12 feet deep (PBCDERM 1990 reported a depth of six feet). Freshwater inflows to Lake Worth Lagoon are given in Table 1. The Lagoon is rapidly flushed by tidal action (mean tidal range at the Boynton Inlet is 2.5 feet); the estimated residence time to replace 50% of the resident water is one day [PBCDERM 1990]. The Lake Worth and Boynton Inlets are shown in Figure 1, along with the nearby South Central treated-wastewater plant ocean outfall.

Table I: Freshwater inflows to Lake Worth Lagoon[1]

Source	Percent of Inflow
West Palm Beach Canal (C-51)	49.7
Earman River (C-17)	12.5
Boynton Canal (C-16)	10.7
West Palm Beach STP[2]	1.3
Boynton Beach STP[2]	0.3
Groundwater	22.3

1: data from South Florida Water Management District, 1977
2: Sewage treatment plants, which no longer discharge into the Lagoon

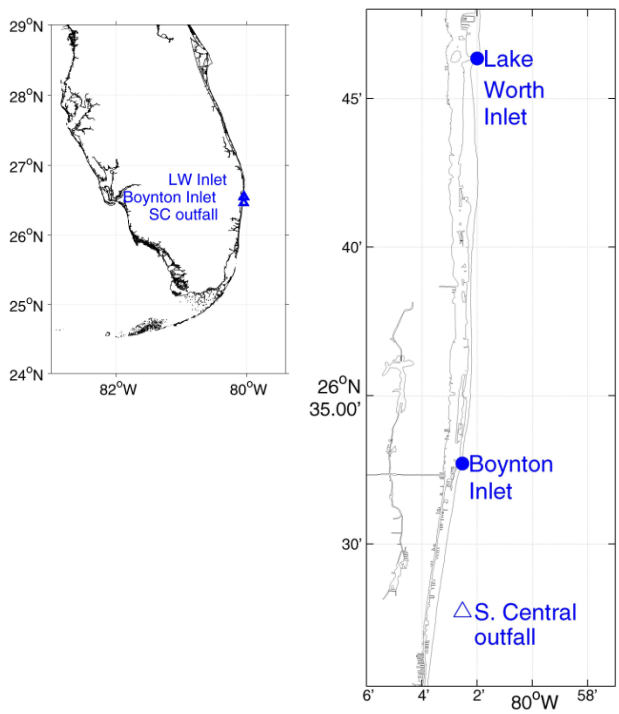

Figure 1. Location of the Boynton Inlet and Lake Worth Inlet that drain the Lake Worth Lagoon, and the South Central treated-wastewater ocean outfall.

Point source discharges into the Lake Worth Lagoon have been significantly reduced in recent years. Untreated wastewater discharges were replaced in the 1970s by major wastewater treatment plants. Discharge from these plants was reduced to ~3 MGD of secondarily treated effluents in 1984. By 1990, three wastewater treatment plants discharged a total of ~1.26 MGD of secondarily treated wastewater effluent into the Lake Worth Watershed [, 1990]. A study of the nutrients in Lake Worth Lagoon [PBCDERM 1990] concluded that the major pollution sources for the Lagoon were the canal inflows.

In 2006, the Atlantic Oceanographic and Meteorological Laboratory of the National Oceanic and Atmospheric Administration entered into an agreement with the Florida Water Environment Association Utility Council as a part of the Florida Area Coastal Environment (FACE) program. A principal purpose of the agreement was to design a scientific study to investigate the principal sources of nutrients for selected locations in the coastal waters of Southeast Florida. Scientific investigations pursuant to this agreement had indicated that the Boynton Inlet was likely to be a significant source of anthropogenic material to the coastal ocean. It was decided that a long-term investigation of the Boynton Inlet water flow would be established, and that an intensive study of chemical and biological measurements of water flowing through the Inlet for 48 hours was necessary to understand the impact of the Inlet on the coastal ocean (June 4-5). A second 48-hour intensive (September 26-28) was performed because of deficiencies found in the first Intensive. In addition, this presented an opportunity to see how consistent the measurements would be during the two intensives.

Because the flow in the Inlet is principally tidally driven, there are two outflow/inflow cycles through the Inlet each day. A 48-hour time period then provides four outgoing and four incoming flows for investigation in each intensive. Between each pulse is a short time (~ten minutes) of nearly zero flow. The Inlet and the automobile bridge over the Inlet is shown in Figure 2.

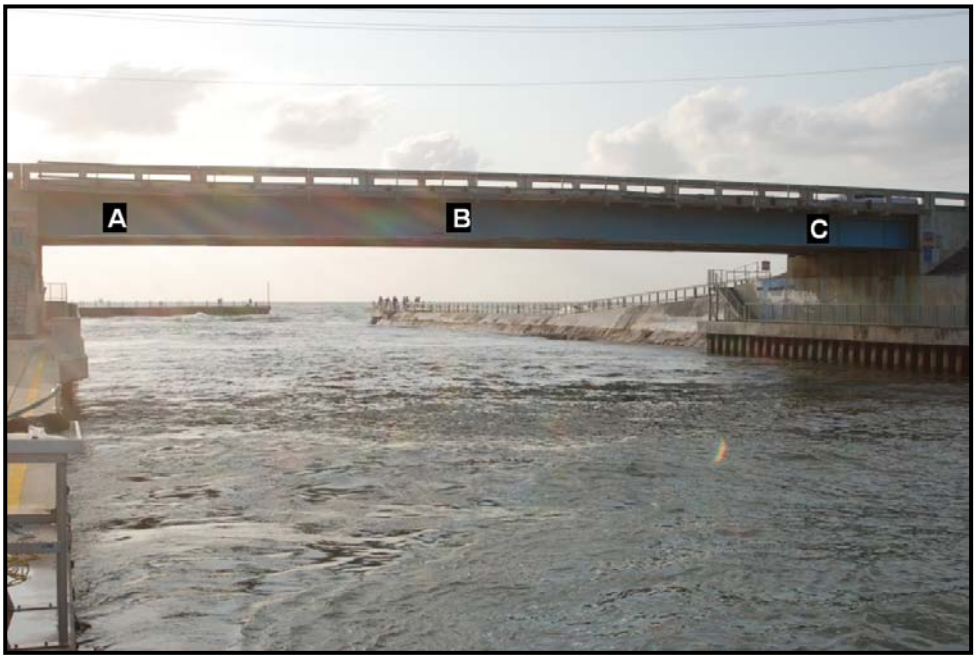

Figure 2. The Boynton Inlet bridge showing the three locations for water sampling in the September intensive (A = North end, B = Center, and C = South end). A sample was collected from position B every hour on the incoming tide and every half hour on the outgoing tide. A sample was collected from all three positions (A, B, and C) once during an outgoing tide to measure variability in the nutrient concentrations across the channel.

Field Sample Collection Methods

Water Sampling

For the June intensive, sampling commenced at the center of the Boynton Inlet bridge (location B); however, because of instrument difficulties, samples were collected from the south walkway near the overpass. For the September intensive, a sample was collected from position B every hour on the incoming tide and every half hour on the outgoing tide. A sample was collected from all three positions (A, B, and C) once during an outgoing tide to measure variability in the nutrient concentrations across the channel.

Three acid-cleaned 15-L buckets were used to collect water samples from the Boynton Inlet. A single bucket was lowered by rope from the center of the bridge and rinsed three times with sample water before the final sample was collected. The bucket of sample water was transferred into the appropriate sample bottles and bags for subsequent analysis. The sample water was analyzed for δN^{15} isotopes, nutrients (P, Si, NO_2, NO_3, NH_4, total nitrogen [TN] and total organic nitrogen [TON]), total organic carbon (TOC), total suspended solids (TSS), and microbiology. After the first hour of the outgoing tide, three samples were collected from the bridge: A= North side of bridge, B= Center of bridge, and C= South side of bridge in order to sample the possible variations in the various parameters across the channel (Figure 1). In addition, a set of duplicates and a blank were collected on the outgoing tide.

Water samples were filtered through 0.45 µm membrane filters using a 50-ml syringe and collected in two 8-ml polystyrene test tubes, one for Ammonia-N analysis and the other for Nitrate + Nitrite-N, Nitrite-N, silicate and phosphate. Each filter was pre-washed, passing 50 ml of sample water through the filter before taking the final sample. Care was taken to avoid the contamination of nutrient samples especially at low concentrations. Eight-ml polystyrene test tubes were used for sample storage and analysis. Sample tubes were rinsed three times with sample water, shaking with the cap in place after each rinse. Nutrient sample tubes were filled with sample water and frozen until analyzed. Ammonia samples were preserved by addition of 0.2% (V/V) of chloroform and cap firmly and stored on ice until transported back to lab for analysis. This same procedure was done during the September sampling period, however the ammonia samples were collected and stored in 60-ml polystyrene test tubes.

Water samples were collected in pre-cleaned 1-L bottles for TSS measurements.

Water samples were collected for δN^{15} isotope analyses during the September sampling period. Inlet water was collected, in pre-cleaned 250-ml bottles filtered through GF/C 25-mm filters, acidified to a pH of 2-3 with 10% HCl and stored frozen.

Water for microbiological samples was collected in sterile Whirl-Pak® bags and stored on ice until sample processing. Microbiological samples were processed within six hours of collection.

In the field, general physical water quality data (pH, conductivity, salinity, water temperature, dissolved oxygen) was collected using an YSI 556 multi-parameter probe (YSI Inc. Yellow Springs, OH). The probe was calibrated daily. For pH, a three-point calibration was performed with YSI pH standard solutions of 4.0, 7.0, and 10.0. For conductivity, specific conductance, total dissolved solids, and salinity, an YSI standard solution of 10,000 mS/cm was used. For dissolved oxygen, a water-saturated air calibration method was used, as follows: 3 mm (1/8 inch) of water was placed in the bottom of the calibration cup. After 10 minutes, the air in the calibration cup was considered water-saturated, and the dissolved oxygen was calibrated to 100%.

Additional observations that were recorded included general weather conditions, ambient air temperature, tidal conditions, previous rainfall, approximate channel depth, and current direction and strength. This information was collected using a Kestrel K3000 hand-held weather station (Nielsen-Kellerman, Boothwyn, PA) and visual observation.

Flow Measurements

To estimate the volume of water passing through the Boynton Inlet, a Sontek 500-kHz side looking Doppler Sonar was installed on the North side of the inlet on February 20th 2007. This system estimated at 15-minute intervals, the volume of water flowing through The Boynton Inlet. This is accomplished by making simultaneous measurements of the water level at the location of the instrument and of the flow velocity in a measurement cell encompassing approximately the middle 50% of the channel at the location of the instrument. This cell is chosen so that the velocity measured in this cell best represents the mean channel velocity in the inlet. The water level measurement in conjunction with knowledge of the channel geometry gives an estimate of the cross sectional area of the channel. The product of the channel cross sectional area estimate (m^2) and the estimate of the mean channel velocity measurement (m/sec) give the flux of water passing through the channel at that time. (m^3 sec^{-1}) To correct for the particular characteristics of this inlet, a series of calibrations exercises were carried out using a 1200 kHz RD instruments down looking Doppler sonar. This instrument was transected across the inlet at multiple times during the tidal cycle (flood and ebb). During these transects, data was gathered across the entire width of the inlet. Data from these calibration exercises enable the correction of the velocity measurement made by the side looking sonar to more closely represent the true mean channel velocity of the inlet.

Analytical Methods

Particulates

Total Suspended Solids

Samples were measured for TSS at FAU's Laboratories for Engineered Environmental Solutions (Lab.EES). Those samples employed 4.25-cm Whatman® 934-AH glass fiber filter disks (catalog number 1927-042) with nominal pore size of 1.0 µm. The filtration apparatus consisted of three plastic Millipore® 47-mm diameter filter holders with plastic filter support screens, 300-mL magnetic seal filter funnels, and a 4000-mL vacuum filtering flask. Each filter setup was attached to a vacuum filtration manifold using silicone vacuum tubing. A Gast® dry-air vacuum pressure pump with a maximum applied pressure of 15 psi was used. Each filter was pre-rinsed with 3 aliquots of reagent grade water. Approximately 1000 mL of sample was filtered in each test, and the container and graduate cylinder used for transfer were both washed with three aliquots of reagent water to ensure complete transfer of the sample to the filter. Filtered samples were dried at 105°C on pre-labeled aluminum weighing dishes using a Precision Scientific® variable temperature control drying oven. All samples were weighed by difference on a Mettler® AC 100 calibrated top loading balance. The detection limit was 0.1 mg/L. Finished samples were sealed in a plastic bag and delivered to AOML for further analysis of suspended nutrient content.

Turbidity

A portable nephelometer (VWR Model 800 turbidity meter) was used to measure turbidity. Cuvettes were rinsed with reagent water thoroughly before each use and pre-rinsed with three aliquots of sample.

Particulate Organic Matter (POM)

POM was retained on GF/C 25-mm filters that were used to filter inlet water samples and stored frozen.

Nutrients

Nutrient analyses were conducted using the following EPA methods.

Ammonia

Method 349.0 was used to determine the concentration of ammonia for each station (Zhang et al., 1997). This method uses automated gas segmented continuous flow colorimetry for the analysis of ammonia. Ammonia in solution reacts with alkaline phenol and NADTT at 60 ^{0}C to form indophenol blue in the presence of sodium nitroferricyanide as a catalyst. The absorbance of indophenol blue at 640 nm is linearly proportional to the concentration of ammonia in the sample.

Nitrate + Nitrite

Method 353.4 was used to determine the concentration of nitrate and nitrite for each station (Zhang et al., 1997). This method uses automated gas segmented continuous flow colorimetry for the analysis of nitrate and nitrite. Samples were passed through a copper-coated cadmium reduction column. Nitrate is reduced to nitrite in a buffer solution. The nitrite is then determined by diazotizing with sulfanilamide and coupling with N-1-naphthylethylenediamine dihydrochloride to form a color azo dye. The absorbance measured at 450 nm is linearly proportional to the concentration of nitrite + nitrate in the sample. Nitrate concentrations were obtained by subtracting nitrite values, which have been separately determined without the cadmium reduction procedure, from the nitrite + nitrate values.

Silicate

Method 366.0 was used to determine the concentration of silica for each station (Zhang and Berberian, 1997). This method uses automated gas segmented continuous flow colorimetry for the analysis of dissolved silicate concentration. In the method, β-molybdosilicic acid is formed by reaction of the silicate contained in the sample with molybdate in acidic solution. The β-molybdosilicic acid id then reduced by ascorbic acid to form molybdenum blue. The absorbance of the molybdenum blue, measured at 66 nm, is linearly proportional to the concentration of silicate in the sample.

Orthophosphate

Method 365.5 was used to determine the concentration of orthophosphate for each station (Zimmermann and Keefe, 1997; Zhang et al., 2001). This method uses automated calorimetric and continuous flow analysis for the determination of low-level orthophosphate concentrations. Ammonium molybdate and antimony potassium tartrate react in an acidic medium with dilute solutions of phosphate to form an antimony-phosphomolybdate complex. This complex is reduced to an intensely blue-colored complex by ascorbic acid. The absorbance measured at 800 nm is proportional to the phosphate concentration in the sample.

Total Phosphate

Method 367.0 was used to determine the total phosphorus concentration for each station (Zhang et al, 1998). This method determines total dissolved phosphorus (TDP) concentration by autoclave promoted persulfate oxidation of organically bound phosphorus followed by a gas segmented continuous flow colorimetric analysis of digested samples. In this method, dissolved organic phosphorus (DOP) in the water reacts with persulfate in acidic media at elevated temperature and pressure. An autoclave is used to achieve a temperature of 120^0 C and pressure of 2 atmospheres, which promote oxidation. After samples were cooled to room temperature, aliquot of ascorbic acid is added to remove the free chlorine formed in seawater during the digestion. Those autoclaved samples were then analyzed for phosphate concentrations by the molybdenum blue calorimetric method using a gas segmented continuous flow analysis by a Flow Solution Analyzer. In this method phosphate reacts with molybdenum (VI) and antimony (III) in an acidic medium to form an antimonyphosphomolybdate complex. This complex is subsequently reduced by ascorbic acid to form a blue complex and the absorbance measured at

710 nm. Undigested samples were analyzed separately to obtain the concentration of dissolved inorganic phosphate (DIP). Dissolved organic phosphorus is calculated as the difference between total dissolved phosphorus and dissolved inorganic phosphorus (DOP = TDP – DIP).

Total Nitrogen (TN)

TN was measured using the thermal decomposition/NO detection chemiluminescence method in a Teledyne/Tekmar Apollo 9000 total organic carbon analyzer with total nitrogen module. When a sample is introduced into the combustion tube (furnace temperature 7200° C), the TN in the sample decomposes to nitrogen monoxide. Nitrogen gas does not become nitrogen monoxide under these circumstances. The carrier gas (pure oxygen), which contains the nitrogen monoxide, is cooled and dehumidified by the electronic dehumidifier. The gas then enters a chemiluminescence gas analyzer, where the nitrogen monoxide is detected. The detection signal from the chemiluminescence gas analyzer generates a peak, and the TN concentration in the sample is measured against a five-point standard curve.

Total Organic Nitrogen (TON)

Dissolved organic nitrogen is calculated by subtracting the amount of dissolved inorganic nitrogen from the total dissolved nitrogen.

Total Organic Carbon (TOC)

Samples were placed in a pre-cleaned 40 ml glass vial and placed in the auto-sampler of the Teledyne/Tekmar Apollo 9000 total organic carbon analyzer. This method determines the organic content after the removal of inorganic carbon. The sample is acidified to a pH of 2 to 3 and subsequently degassed. Carbonates are not stable at this pH value and therefore, form carbon dioxide. The inorganic carbon is removed by purging. The organic carbon content of the sample was introduced into a combustion tube filled with a platinum oxidation catalyst and heated to 6800° C. The sample is oxidized in the combustion tube, and the contents converted to carbon dioxide. Carrier gas, which flows at a rate of 150 mL/min to the combustion tube, carries the sample combustion products from the combustion tube to an electronic dehumidifier, where the gas is cooled and dehydrated. The gas then carries the sample combustion products through a halogen scrubber to remove chlorine and other halogens. Finally, the carrier gas delivers the sample to the detector, and then is measured against a five-point standard curve to determine the total organic carbon content.

Nitrogen isotopes

DIN- NO3-+ NO2- samples were processed as follows. Nitrate is quantitatively converted to nitrite through cadmium reduction and then further reduced to nitrous oxide (N_2O) with a 1:1 azide and 20% acetic acid buffer solution. The N_2O produced is then analyzed on a continuous flow, purge and trap system interfaced with PAL autosampler and a GV IsoPrime stable isotope mass spectrometer for δN^{15} and δO^{18}. Samples with less than 0.5µM NO_3^- + NO_2^- were excluded due to machine limitations.

DIN- NH4+- Ammonium is quantitatively converted to NO_2^- by hypobromite (BrO^-) addition under basic conditions using methodology established by{citation}The NO_2^- produced is reduced to N_2O with a 1:1 azide and 100% acetic acid buffer solution. The N_2O produced is then analyzed on an automated continuous flow purge and trap system interfaced with a GV IsoPrime stable isotope mass spectrometer for $\delta^{15}N$. Samples with greater than 0.1 µM NO_2^- were excluded from analysis due to $\delta^{15}N$ contributions from NO_2^- and samples with less than 0.5 µM NH_4^+ were excluded due to machine limitations.

POM- Particulate Organic Matter filters were freeze-dried prior to analysis. The area of the filter containing filtrate were removed, split in half, placed in 5x3.5 mm tin capsules for dual analysis of $\delta^{15}N$ and $\delta^{13}C$ on a

Europa Scientific ANCA GSL prep device interfaced with a 20/20 continuous flow stable isotope ratio mass spectrometer.

Microbiology

Viable bacterial indicators

These were enumerated by the EPA-approved Chromogenic Substrate Most Probable Number Method. Sample processing and analysis followed the procedures outlined in Standard Methods (APHA, AWWA, and WEF 1995). Bacteriological samples were analyzed within 6 hours of collection by the Laboratories for Engineered Environmental Solutions (Lab.EES) using the chromogenic substrate technique (IDEXX Colilert™ Test) for total coliform and *E. coli* (SM9223B) and the IDEXX Enterolert™ test for Enterococci (SM9230C). All samples were diluted 1:10 with sterilized reagent water to reduce the ionic strength of the marine water matrix. Field duplicates and laboratory replicates were analyzed for approximately 10% of the samples.

Protozoan cysts

These were eluted from FiltaMax™ filter cartridges (IDEXX) with an automated FiltaMax Wash Station using 1X PBST buffer according to manufacturer's directions. Enumeration of protozoan *Cryptosporidium* oocysts and *Giardia* cysts in the eluate is conducted by immunomagnetic separation and immunofluorescent microscopy according to EPA standard method 1623.

Total community bacterial populations

These were harvested from water samples by filtration of 1 L water samples onto cellulose nitrate membrane filters (0.45 um pore size), followed by extraction of total genomic DNA from filters with the FastPrep™ DNA Spin Kit (MPBiomedicals/Qbiogene) according to manufacturer directions. Purified DNA from samples is stored frozen for later analysis of specific bacterial fecal indicators and pathogens by real-time quantitative PCR (qPCR) as described below.

Viruses

These were harvested from water samples by charge affinity using filtration of 1 L water samples onto charged HA-type membrane filters (0.45-µm pore size). Viral RNA is extracted directly from filters by bead beating in a FastPrep instrument with lysis buffer from the VirAmp RNA extraction (Qiagen). Viral RNA is purified from the lysate with the VirAmp Kit as per manufacturer instructions. Purified viral RNA is stored frozen for later analysis of specific viral fecal indicators and pathogens by real-time quantitative reverse-transcription PCR (qRT-PCR) as described below.

Cycling conditions for all source-tracking qPCR assays were run on an MJ Research Chromo4 in 25-µL reaction volumes using QuantiTect Probe Mastermix (Qiagen, Inc.) with 0.125-µL of each primer per reaction (from 100uM stock) and 0.1 µL of probe per reaction (from 100-µM stock). Samples were run in triplicate wells (with 1 well spiked with inhibition control) with the following cycling parameters: 15 min. denaturation at 95° C, followed by 45 cycles of 95° C for 15 sec and 60° C for 1 min with a fluorescent plate read at the end of each extension.

Quantitative PCR:
General Enterococci 23S rRNA gene
Forward primer: 5'-AGAAATTCCAAACGAACTTG-3'
Reverse primer: 5'-CAGTGCTCTACCTCCATCATT-3"
Probe: 5'-6FAM-TGGTTCTCTCCGAAATAGCTTTAGGGCTA-BHQ-3'

Total *Lactococcus lactis* Control 16S rRNA gene

Forward primer: 5'-GCTGAAGGTTGGTACTTGTA-3'
Reverse primer: 5'-TCAGGTCGGCTATGTATCAT-3'
Probe: 5'-6FAM-TGGATGAGCAGCGAACGGGTGA-BHQ-3'

Human-source Bacteroides HF8 gene cluster marker
Forward primer: 5'-ATCATGAGTTCACATGTCCG-3'
Reverse primer: 5'-CAATCGGAGTTCTTCGTG-3'
Probe: 5'-6FAM-TCCGGTAGACGATGGGGATGCGTT-BHQ-3'

Human-source Bacteroides HuBac marker
As per Layton et al., 2005
Norovirus and enterovirus qPCR kits by Cepheid Inc. as per manufacturer's instructions (with some modifications – please contact me for details)

Non Quantitative PCR:

Human-source Enterococci esp gene:
As per Scot et al., 2005

Campylobacter jejuni *hipO* gene:
As per LaGier et al., 2004

Salmonella spp. *IpaB* gene:
As per Kong et al., 2005

Pathogenic E. coli strain O157:H7 *rfb* gene:
As per Maurer et al., 1999

Staphylococcus aureus clfA gene:
As per Mason et al., 2001

Human Adenovirus Hexon gene:
As per He and Jiang, 2005Additional analysis of viruses conducted by Dr. Jill Stewart of the Oceans and Human Health Center at Hollings Marine Lab.

Standards and Controls for quantitative PCR:

Quantitation standards for total bacteroides and human source bacteroides use purified genomic DNA from the culture *Bacteroides dorei*, measured by fluorescence with a Qubit Fluorometer using the Molecular Probes Quant-It kit for dsDNA. Quantitation units for these qPCR assays were in genome equivalents (which can then be expressed as relative cell numbers with some assumptions/caveats about average target copy number in the environmental population of target cells). Quantitation standards for total and human-specific *esp*-containing enterococci were based on purified genomic DNA from a culture of *Enterococcus faecium* that contains the *esp* marker (acquired from Dr. Troy Scott at BSC Laboratories). Quantitation units for these qPCR assays were in genome equivalents.

Extraction control: as above each sample is spiked before lysis and extraction with 10^5 cells of an enumerated control culture of *lactococcus lactis*. Variations in CT value of lactococcus indicate variations of extraction efficiency plus any potential inhibition. Variation due to inhibition is removed by comparing extraction controls to inhibition controls.

Inhibition controls: reactions of each sample run in triplicate, one replicate well of each sample gets spiked with known amount of target DNA. Variation in CT of spike is corrected for background of unspiked for that sample, and indicate degree of inhibition.

Data Summary and Discussion

Nutrients

During flood tide, the water was coastal marine water and was found to be quite low in nutrients; however, the ebb tidal flow was characterized by elevated nutrients and microbiological markers, and was seen to be highly colored (probably due to tannic acid). Figure 3 is a plot of the flow and nutrient data for the two intensives. (Si concentrations have been divided by 10 to fit on the graph). Phosphate measurements were obtained during the June intensive but are not shown because of possible contamination.

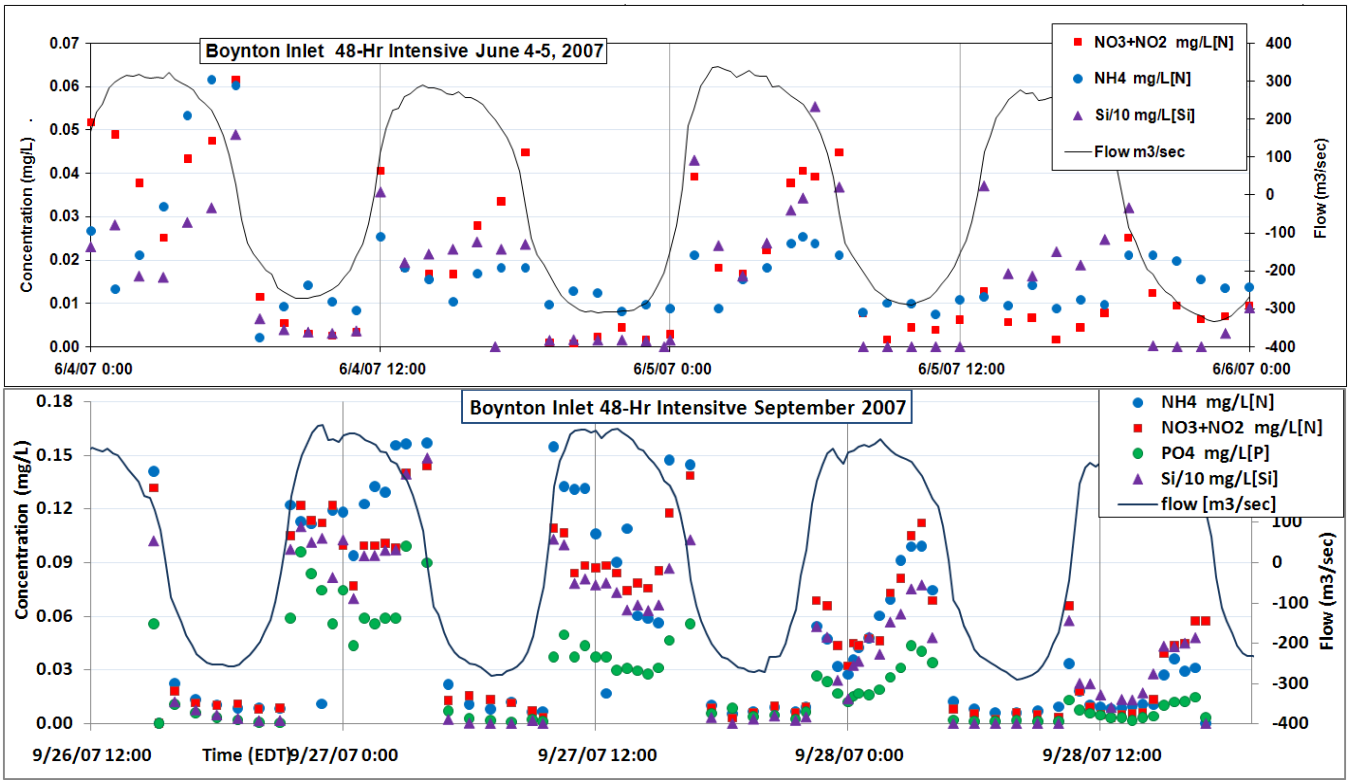

Figure 3: Comparison of nutrient concentrations over two complete tidal cycles for the June (upper panel) and September intensive (lower panel).

The outgoing waters contain higher nutrient concentrations than the incoming waters, especially in September. In addition, we note that the highest concentrations are obtained not at the time of maximum flow, but rather when the flow is minimal (maximum in first derivative of velocity). While the data does not provide an explanation for these observations, it suggests that the flow patterns from the Lagoon are different for different flow rates, and that nutrient concentrations in the Lagoon may not be spatially homogeneous.

Nutrient Ratios

The ratios of the nutrients during different times in the tidal cycle should provide information regarding the composition of the source water as well as of the homogeneity of the Inlet flow. In Figure 4, nutrient concentrations are plotted versus flow rate. As we have seen, inbound flow concentrations are much lower than outbound. Also, the increase in concentration at lower flow rates is evident. In the right panels, concentration ratios from measurements taken at the same time are given; here, open symbols refer to outbound flow measurements while closed symbols indicate inbound flow measurements. The nutrients are not highly correlated; there is, however, there is a suggestion of a difference in the water masses, which argues against a view that the incoming water is just outgoing water that has been diluted by very low nutrient marine waters.

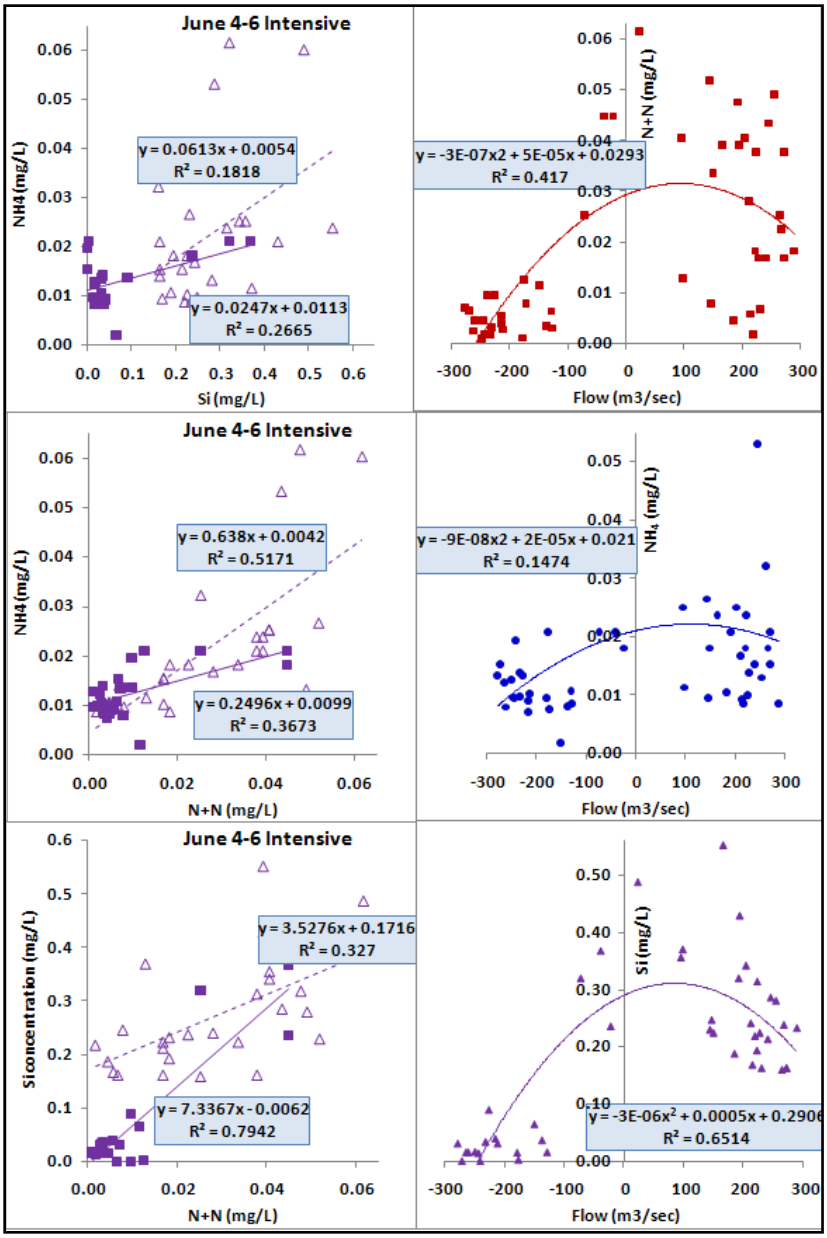

Figure 4: Nnutrient concentrations during the June intensive. In the left panl, various nutrient ratios are given; here, open symbols refer to outbound flow measurements while closed symbols indicate inbound flow measurements. These data suggest that the incoming water is more fundamentally different in nature than outgoing water, in constrast to the September results (see below). The right panels show the concentration of each nutrient versus inlet flow (inbound flow is negative, outbound is positive). Lines and text boxes show regreassion statistics. Higher concentrations at lower flows are evident.

Concentration ratio data for the September intensive are given in Figure 5. Recall that for September, more samples were taken during outgoing flow than for incoming flow, and that useable orthophosphate measurements were made. The leftmost panels show the ratio of various nutrients. Here, we have sectored the

measurements into two cohorts, one with orthophosphate > 0.06 mg/L (blue triangles, Δ) and a second cohort where P ≥ 0.06 mg/L (outgoing flow □ , incoming flow ■). This may be due to different sources for the water within the Lagoon. For the P < 0.06 mg/L results, the concentrations are highly correlated, with similar slopes for incoming and outgoing flow. These data suggest that the nutrient characteristics of the waters that return in during flood (incoming) tides are similar to that from ebb (outgoing) tides but with low-nutrient marine water mixed in. In the right-hand panels, nutrient concentration are plotted against inlet flow. Results from samples with P≥ 0.06 mg/L are denoted with blue triangles. In the right-hand panels we see the dramatically higher concentrations and higher variability in the outbound flow. Higher concentrations at low flow are also evident.

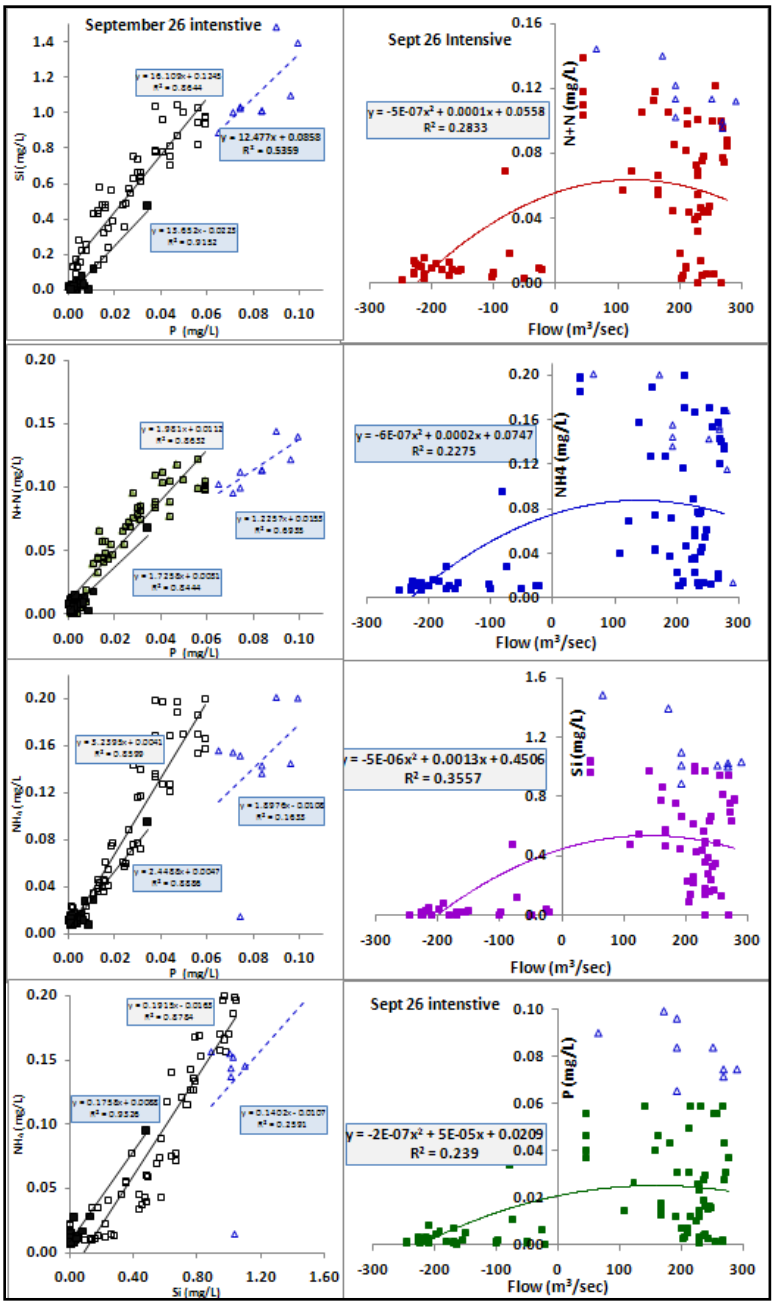

Figure 5: Nutrient concentrationss during the September intensive. The leftmost panels plot nutrient conecntrations (Si, N+N, NH4) versus P (bottom panel versus Si). Results where [P] > 0.06 mg/L are indicated by blue triangles; [P] ≤ 0.06 mg/L are denoted by solid squares for incoming flow and open squares for outgoing flow; regression statistics for each are shown. In the righ panel, the indicated concentrations are shown plotted versus corrected flows into (negative flows) and out of (positive flows) the Boynton Inlet. Samples with P> 0.06 mg/L (not separately denoted) were generally subsumed into the outbound data in the righmost panels.

The flux of material exiting the Inlet into the coastal ocean can be computed from the corrected flows through the inlet and the concentrations obtained during the sampling intensives. These data are shown in Figure 6 and in Table 2. Results indicate that the outgoing tide contains significant amounts of nutrients, especially silicate.

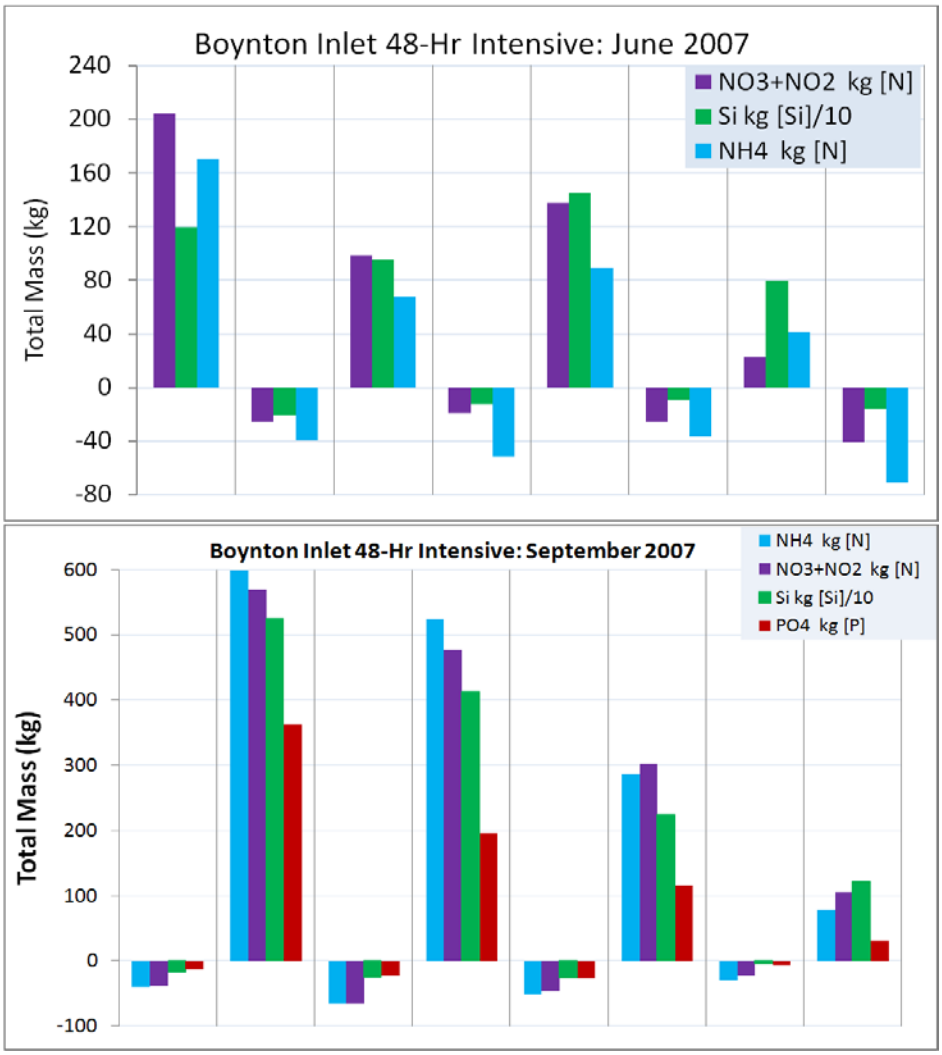

Figure 6: Comparison of nutrient loading between two 48-hour intensive sampling periods, for the June Intensive (upper panel) and September Intensive (lower panel). Note that Silica values have been reduced by 10 for plot readability.

Table 2. Net mass [kg] of nutrients into the coastal ocean for eight ebb tide (out-flowing) pulses.

Nutrient	June 2007				September 2007				(per pulse)	
	1	2	3	4	1	2	3	4	Ave	Stdev
N+N [as N]	240	99	138	23	569	476	303	105	240	195
Si [as Si]	1196	995	1452	798	5255	4134	2248	1215	2157	1652
PO_4 [as P}	*	*	*	*	362	195	116	31	176	141
NH_4 [as N]	171	68	89	41	599	524	286	78	223	218

* orthophosphate (P) values for the June intensive were not included (see text).

To determine if there were consistent concentration gradients across the north-south extent of the Inlet during the September intensive, samples were simultaneously taken from locations A-B-C (Figure 1) and given in

Table 3. These measurements were then scaled by dividing each measurement by the average from the three locations and plotted in Figure 7. No consistent gradient is evident, implying that the waters at this point in the inlet were well mixed in the north-south direction.

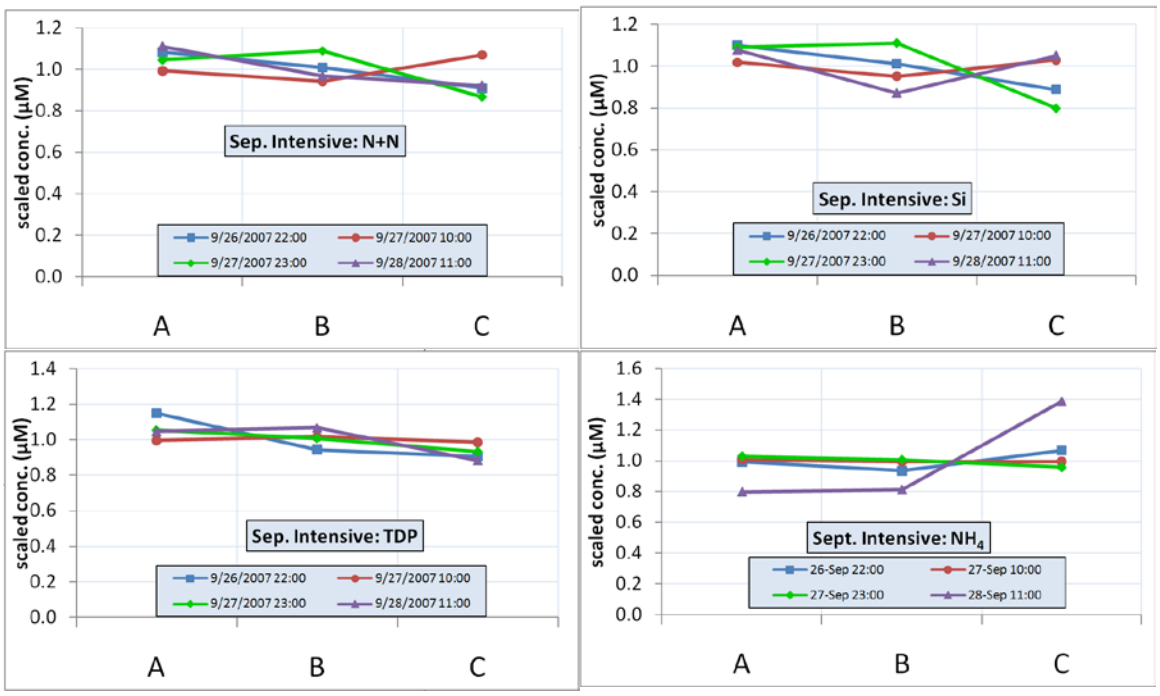

Figure 7: Variation in concentration of N+N, Si, TDP, and NH4 from the three sampling sites indicated in Figure 2.

Table 3: Results from the three sampling sites indicated in Figure 2.

Day/Hour	Decday	test	N+N	NO_2	NO_3	Si	P	TDP	DOP
EDT	GMT	tube	µM	µM	µM	µM	µM	µM	µM
9/26/2007 22:00	270.083333	11A	8.7	0.75	7.95	39.2	3.1	3.43	0.33
9/26/2007 22:00	270.083333	11B	8.10	0.59	7.51	36.1	2.7	2.81	0.11
9/26/2007 22:00	270.083333	11C	7.3	0.56	6.74	31.7	2.1	2.70	0.60
9/27/2007 10:00	270.583333	30A	7.8	0.54	7.26	36.7	1.2	2.64	1.44
9/27/2007 10:00	270.583333	30B	7.4	0.42	6.98	34.3	1.3	2.70	1.40
9/27/2007 10:00	270.583333	30C	8.4	0.64	7.76	37.1	1.5	2.61	1.11
9/27/2007 23:00	271.125000	51A	4.7	0.45	4.25	17.2	0.75	1.21	0.46
9/27/2007 23:00	271.125000	51B	4.9	0.53	4.37	17.5	0.8	1.15	0.35
9/27/2007 23:00	271.125000	51C	3.9	0.4	3.5	12.6	0.76	1.07	0.31
9/28/2007 11:00	271.625000	70A	4.7	0.44	4.26	20.5	0.42	1.15	0.73
9/28/2007 11:00	271.625000	70B	4.1	0.37	3.73	16.6	0.5	1.18	0.68
9/28/2007 11:00	271.625000	70C	3.9	0.33	3.57	20	0.58	0.97	0.39

Inputs into Lake Worth

Although the ebb tide flow out the Inlet is about the same for the eight pulses (Figure 3), considerable variation in out-flowing nutrient masses for the eight ebb tide pulses should be noted. We noted above that in general

nutrient concentrations in flood tides are low but in ebb tides are quite elevated; and, the quantities of out-flowing nutrient masses in the June intensive are considerably lower compared to the September intensive.

To elucidate these observations, we examine inputs into the Lake Worth Lagoon prior to the intensives. Rainfall from the vicinity of the Lagoon (DBHYDRO sites #16674, 16583, and 16675) is shown in Figure 8. A very strong rain event occurred on 2-June-2007, dropping over eleven cm of rain which resulted in a large total canal flow on that day. By the time of the intensive on 4-June, the low levels of the N+N and NH4 may be indicating a 'washing out' of those nutrients in the lagoon, with silica and phosphorous remaining. Evidently, silica was still in suspension on the first outgoing ebb tide of the June intensive. For the September intensive, rain was present up to the beginning of the Intensive, so that the 'washing out' of the nutrients is still in progress.

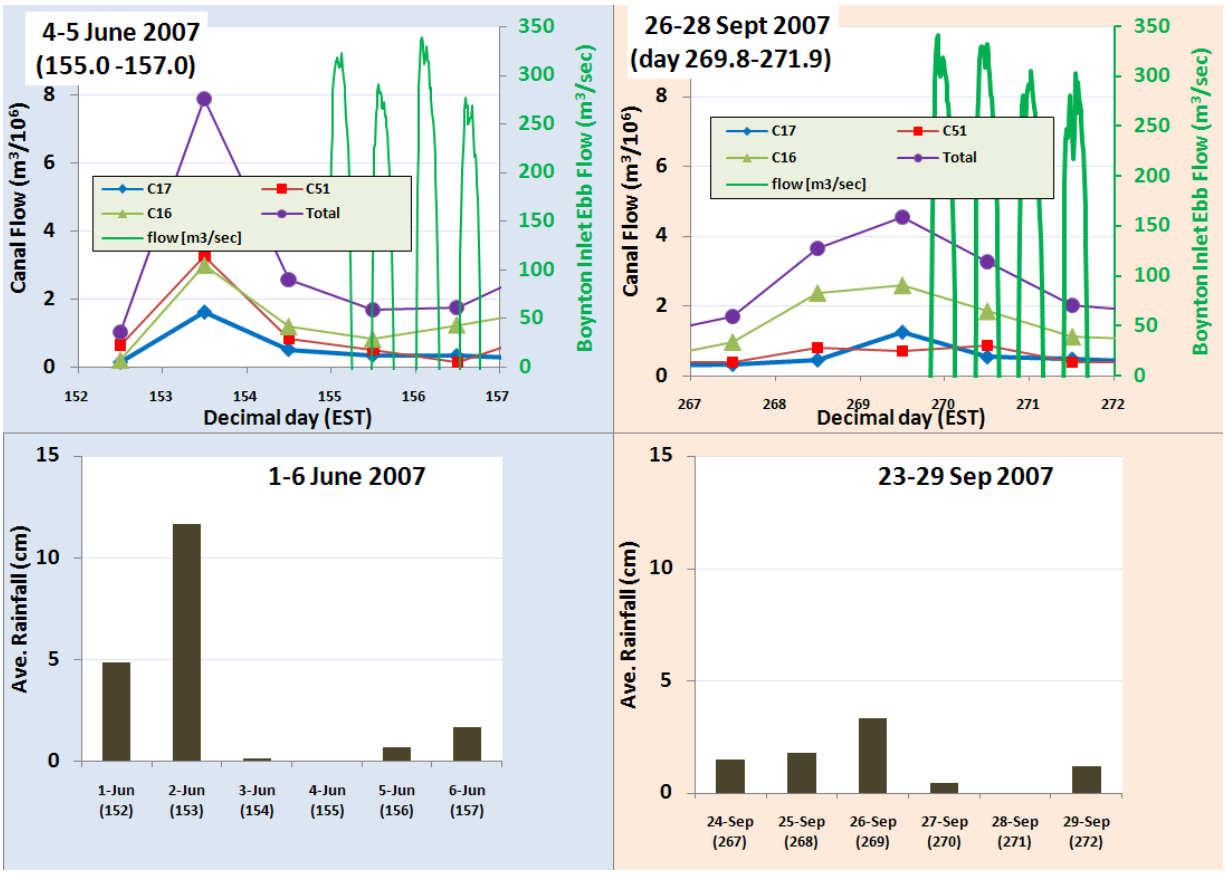

Figure 8. Rain (lower panels), canal (C16, C17, C51, and total) and inlet ebb tide water flow (upper panels) for June (left panels) and September (right panel) intensives. Green lines indicate ebb tide flow through Inlet during each intensive. Flow and rain data are from FDEP (DBHYDRO).

FAU results

Samples were obtained by FAU during the June intensive to augment the data set. These samples were analyzed for a number of parameters not measured elsewhere. A summary of these results is given in Figure 9 and Table 4 and in the appendix.

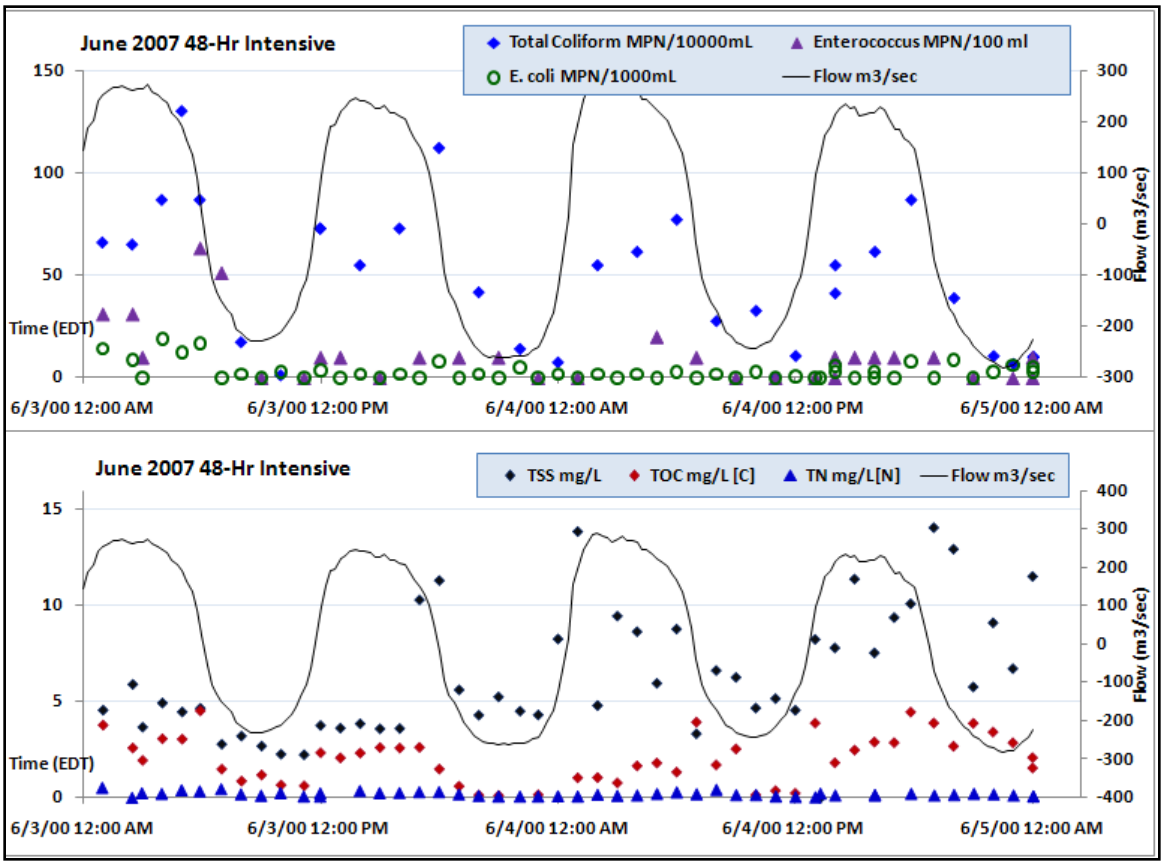

Figure 9. Upper panel: water flow (black line), total coliform, e.coli. and eterococcus measurements by FAU during the June intensive. Lower panel: water flow (black line), total suspended solids, tcal organic carbon, and total nitrogen measusrments by FAU during the June intensive.

Table 4. Physical, chemical and microbiological meaurements collected during the June intensive study by FAU.

Date	Hour (EDT)	pH	TDS mg/L	Salinity ppt	DO mg/LO_2	Turb NTU	TSS µg/ml	Enterococcus MPN/100mL
6/4/2007	4:00	8.68	28.68	28.45	5.50	1.71	4.98	10
6/4/2007	10:00	8.77	35.39	36.08	4.62	0.04	2.31	<10
6/4/2007	16:00	9.09	30.38	30.28	4.20	1.00	3.64	10
6/4/2007	22:00	8.17		36.30	4.81	0.00	4.55	<10
6/5/2007	4:00	7.88		30.52	4.90	1.03	8.69	20
6/5/2007	10:00	8.00		36.34	4.81	0.24	4.71	<10
6/5/2007	16:00	7.71	30.17	30.05	4.44	1.70	7.58	10
6/5/2007	16:00					1.56		10
6/5/2007	22:00	7.60	34.35	35.01	4.91	0.22	9.15	<10

Microbiology

A selected subset of the data collected to date is presented here and in Appendix V and VI. The inlet appeared to be a source of microbial contaminants to near shore waters as indicated by a higher percentage of positive detections for pathogens, fecal indicator bacteria (FIB), and source tracking markers associated with the outgoing tide versus the ingoing tide (Fig. 10). A variety of microbial contaminants were detected in outgoing tides from the inlet (Figure 11). In comparison, water samples taken from the boil and near the bottom of the SCRWWTP outfall (the closest outfall to the Boynton inlet) did not yield positive results during a February 2007 field campaign (Table 1). A low amount of enterococci DNA (<30 genome equivalents) was detected at the SCRWWTP boil during a July 2008 cruise, and the abundance declined with distance from the outfall (Figure 11).

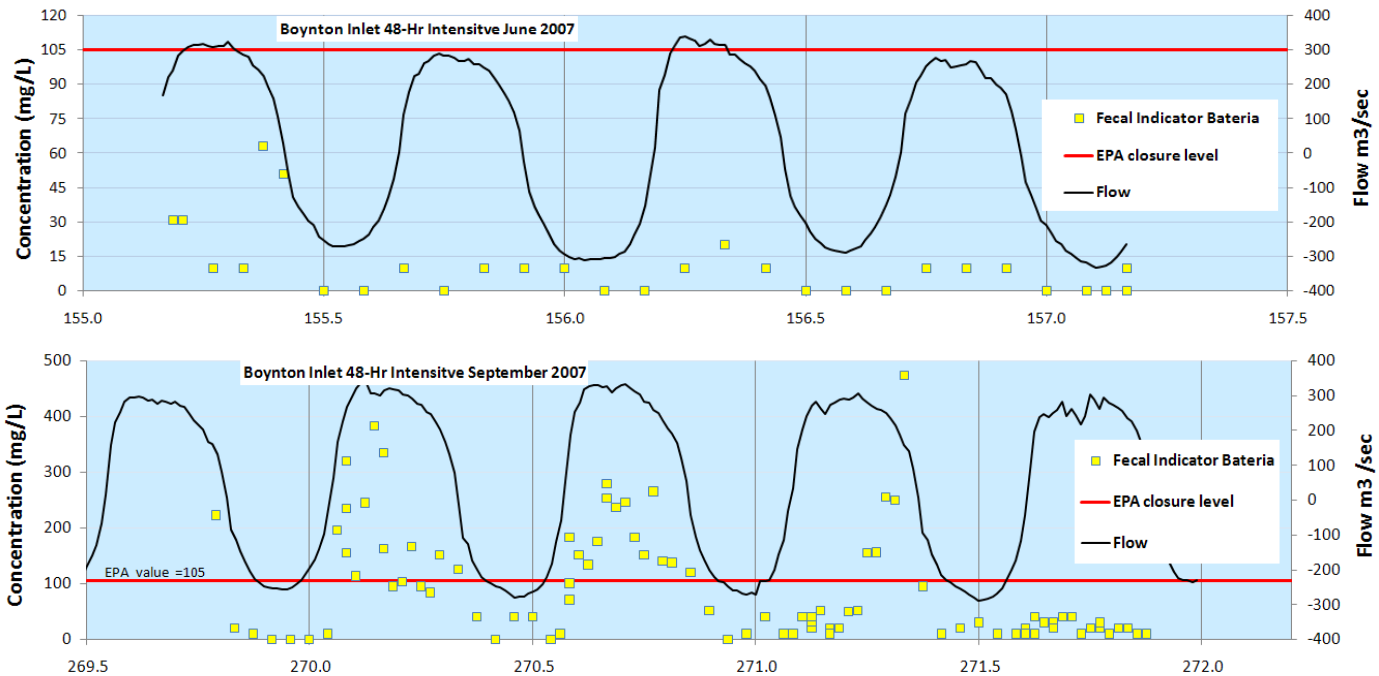

Figure 10: Positive detection of bacteria over two complete tidal cycles for June 2007 (upper panel) and September 2007 (lower panel). EPA closure level is shown by the red horizontal line.

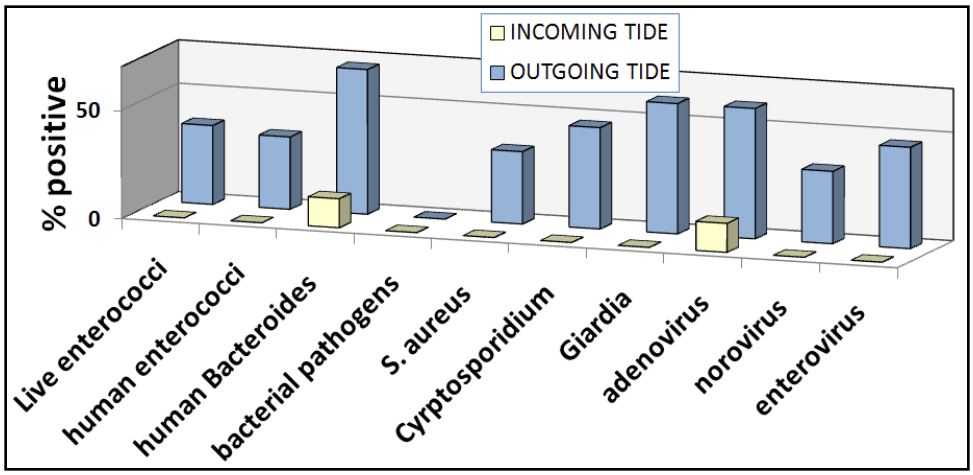

Figure 11: Breakdown of results by test for the September 2007 study. Data show the % of samples showing positive detection for microbial contaminants out of 15 discrete time points. "Bacterial pathogens" is a composite for *C. jejuni*, *Salmonella* spp., and *E. coli* O157:H7.

Compared to the SCRWWTP outfall, samples from other outfalls yielded higher abundances of *Cryptosporidium* oocysts and *Giardia* cysts (Table 1). In general, the abundance of protozoan cysts appeared to dilute with distance from the outfall because cysts were not detected at a distance of 1 km from the outfall (data not shown). The abundance of Norovirus and the human-associated FIB, *M. smithii* also were higher at the other outfalls tested (Table 2). These data (Tables 1 and 2) provide a measure of total abundance; the percentage of viable organisms is currently not known and is potentially low for these chlorinated effluents discharged into sun-lit coastal waters.

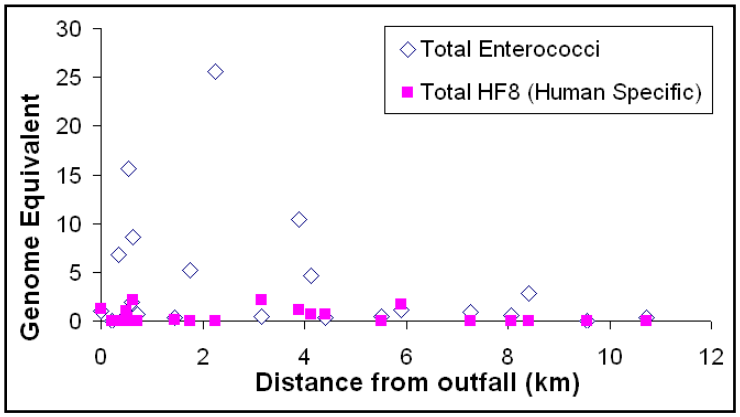

Figure 12: The abundance (genome equivalents) of enterococci and a human-specific Bacteroides (HF8) as measured by qPCR versus distance from the SCRWWTP outfall (data from July 2008 R/V Walton Smith cruise).

Table 5: Abundance of Cryptosporidium and Giardia measured in wastewater boils from a October 2006 cruise aboard the R/V Nancy Foster. South Central boil = the SCRWWTP outfall.

Location	Cryptosporidium oocysts/100 L	Giardia cysts/100 L
South Central Boil	not determined	not determined
Hollywood Boil	55	67
Boca Raton Boil	<1	<1
Broward Boil	8	2
Miami Central Boil	236	246
North Miami Boil	8	120

Table 6: Abundance of the human-specific FIB, M. smithii, and human viral pathogens of the norovirus group measured by qPCR from surface water of wastewater boils (see Fig. 1) from a Feb. 2008 cruise aboard the R/V Nancy Foster. (GE = Genome Equivalents)

Location	*M. smithii* (GE/100ml)	Norovirus (GE/100ml)
South Central Boil	700	not detected
Hollywood Boil	300,000	235
Boca Raton Boil	27,000	2.3
Broward Boil	37,000	6.3
Miami Central Boil	340,000	11
North Miami Boil	130,000	347
Deep Water Control	not detected	not detected

Nitrogen Isotopes.

Samples were analyzed for ^{15}N in ammonia according to the procedures described above. Results are give in Table 7 and in Figure 12.

Table 7: Results for ^{15}N

#	Time (EDT)	$\delta^{15}NH_4^+$	#	Time (EDT)	$\delta^{15}NH_4^+$	#	Time (EDT)	$\delta^{15}NH_4^+$
1	9/26/2007 15:00	**-4.30**	29	9/27/2007 9:30	**-0.44**	55	9/26/2007 20:00	**-0.22**
4	9/26/2007 16:00	**19.38**	31	9/27/2007 10:30	**-3.45**	57	9/26/2007 21:30	**0.44**
6	9/26/2007 18:00	**7.83**	33	9/27/2007 11:30	**-0.11**	59	9/26/2007 22:30	**-3.41**
8	9/26/2007 20:00	**2.44**	36	9/27/2007 12:30	**-1.76**	61	9/26/2007 23:30	**-4.41**
10	9/26/2007 21:30	**-4.62**	38	9/27/2007 13:30	**1.00**	64	9/27/2007 0:30	**8.93**
12	9/26/2007 22:30	**-8.19**	40	9/27/2007 14:30	**-0.93**	68	9/27/2007 1:30	**-5.23**
14	9/26/2007 23:30	**-1.96**	42	9/27/2007 15:30	**-3.56**	69	9/27/2007 2:30	**8.27**
17	9/27/2007 0:30	**0.06**	44	9/27/2007 17:30	**2.30**	71	9/27/2007 5:00	**3.76**
19	9/27/2007 1:30	**-4.98**	46	9/27/2007 19:30	**-6.90**	74	9/27/2007 7:00	**1.27**
21	9/27/2007 2:30	**-4.46**	48	9/27/2007 21:30	**-6.13**	76	9/27/2007 9:30	**7.01**
24	9/27/2007 5:00	**3.47**	50	9/27/2007 22:30	**-2.69**	78	9/27/2007 10:30	**7.91**
26	9/27/2007 7:00	**3.20**	52	9/27/2007 23:30	**0.90**	80	9/27/2007 11:30	**5.66**

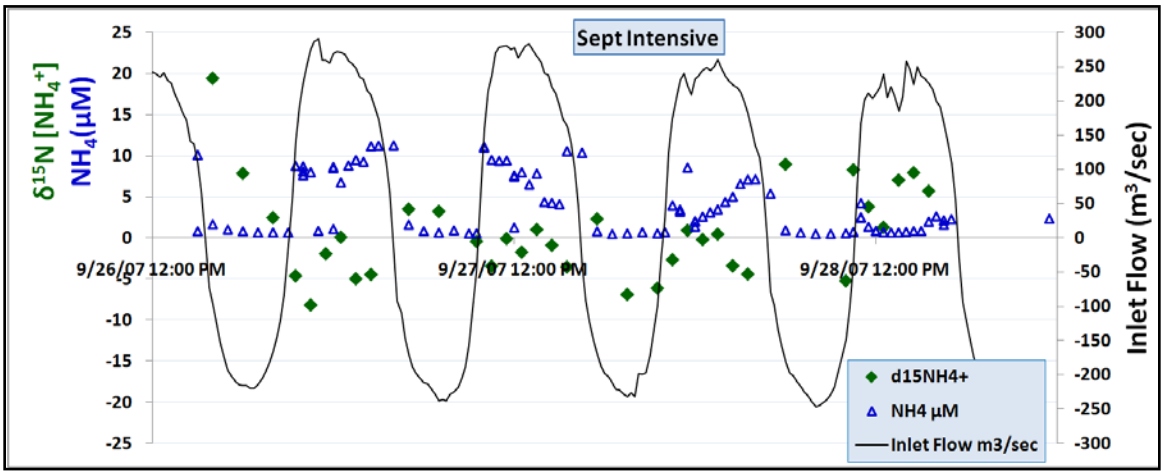

Figure 13. Stable isotope data with flow and ammonium concentrations for the September intensive.

Summary

The FACE project collected a variety of data during the two Intensives, including nutrient, microbiological, and oceanographic information to help understand the processes that effect Florida's coastal environment and coral reef habitats. Measurements of the type presented here represent an important first step to elucidating the environmental impact of waters entering the coastal zone. These data suggest that inlets are important contributors of nutrient and microbiological loads to the coastal zone. The data highlight the need to assess the coastal zone in a cohesive way, especially if data will be used to determine the impacts of land-based pollutants, anthropogenic water discharges, for guidance in the operation and development of water and sewer infrastructure, and for the formulation of science-based regulation. The overall view presented is that the lagoon input into the Inlet is substantial but is also highly variable.

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Appendices

Data elements common to both Boynton Inlet 48 hour intensive sampling periods, are summarized in Appendices I-IV. Each sampling period has duplicate tables showing the principal nutrient concentration units µM and mg/L. Concentrations in relation to tidal flow are clearly shown, using (blue) incoming and (yellow) outgoing. Please note that some data elements may be present in one sampling period, but not in the other. An "ns" denotes not sampled, and "na" denotes not available. Phosphate measurements were obtained during the June intensive sampling but were not included in summary graphics due to possible contamination of those samples. Total Organic Nitrogen was not available in September tables due to a breakdown of the analytical system at FAU, and nitrogen isotope ratio analysis was only done in the September sampling period.

Mass transport values reported in Appendices III and IV were computed using flow data (measured every 15 minutes) and concentration values from samples measured at the same time as the flow data, or, from values interpolated from the preceding and subsequent concentration measurements.

Appendix I. Nutrient results from the June 2007 Sampling Intensive.

Date/Time	Time	Flow	Flow	Temp	Sample	NH_4	NO_2+NO_3	Si	PO_4	DO	TOC	TN	TON	NH_4	NO_2+NO_3	Si	PO_4*	DO	TOC	TN	TON	TSS	pH	Salinity	Turbidity
GMT	EDT	[m^3/sec]	corr.	[^oC]	Number	µM	µM	µM	µM	µM	µM	µM	µM	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		ppt	NTU
6/4/2007 4:00	0:00	168.7	143.4	26.61	**1**	1.48	0.48	8.23	0.15	156.9	228.4	38.85	33.25	0.03	0.05	0.23	0.01	5.02	2.74	0.54	0.47	5.00	8.44	30.18	1.39
6/4/2007 5:00	1:00	298.2	253.4	26.54	**2**	0.73	0.45	10.03	0.10	162.8	315.8	1.07	-3.37	0.01	0.05	0.28	0.01	5.21	3.79	0.02	-0.05	4.60	8.58	27.75	1.85
6/4/2007 6:30	2:30	307.9	261.6	26.62	**3**	1.17	0.35	5.82	0.05	149.1	216.7	18.36	14.16	0.02	0.04	0.16	0.00	4.77	2.6	0.26	0.20	5.94	8.72	31.51	0.71
6/4/2007 7:00	3:00	309.9	263.3	26.56	**4**	1.79	0.23	5.72	2.09	149.1	163.3	16.50	12.40	0.03	0.03	0.16	0.20	4.77	1.96	0.23	0.17	3.71	8.65	31.86	1.39
6/4/2007 8:00	4:00	287.9	244.6	26.48	**5**	2.96	0.40	10.23	0.19	171.9	256.7	26.71	19.81	0.05	0.04	0.29	0.02	5.50	3.08	0.37	0.28	4.98	8.68	28.45	1.71
					5x	n/s	n/s	n/s	n/s	n/s	267.5	30.07	30.07	n/s	n/s	n/s	n/s	n/s	3.21	0.42	0.42	n/s	n/s	n/s	n/s
6/4/2007 9:00	5:00	225.2	191.3	26.46	**6**	3.42	0.44	11.44	0.27	152.2	255.0	26.21	18.41	0.06	0.05	0.32	0.03	4.87	3.06	0.37	0.26	4.51	8.66	28.34	2.03
6/4/2007 10:00	6:00	27.0	23.0	26.45	**7**	3.34	0.57	17.45	0.22	165.0	377.5	34.14	25.44	0.06	0.06	0.49	0.02	5.28	4.53	0.48	0.36	4.70	8.27	23.03	1.74
6/4/2007 11:00	7:00	-175.9	-149.5	26.25	**8**	0.11	0.11	2.31	0.11	143.8	125.3	14.84	13.88	0.00	0.01	0.06	0.01	4.60	1.50	0.21	0.19	2.83	8.68	35.32	n/s
6/4/2007 12:00	8:00	-252.6	-214.6	26.26	**9**	0.51	0.05	1.40	1.89	146.3	73.6	9.51	8.46	0.01	0.01	0.04	0.18	4.68	0.88	0.13	0.12	3.25	8.68	36.90	0.20
6/4/2007 13:00	9:00	-272.0	-231.1	26.29	**10**	0.78	0.03	1.20	2.41	145.0	100.0	19.23	18.01	0.01	0.00	0.03	0.23	4.64	1.20	0.27	0.25	2.73	8.85	35.66	n/s
6/4/2007 14:00	10:00	-248.3	-211.0	26.37	**11**	0.58	0.02	1.10	0.13	144.4	56.7	6.50	5.57	0.01	0.00	0.03	0.01	4.62	0.68	0.09	0.08	2.31	8.77	36.08	0.04
6/4/2007 15:00	11:00	-161.0	-136.8	26.52	**12**	0.46	0.03	1.30	1.08	139.7	53.6	6.29	5.46	0.01	0.00	0.04	0.10	4.47	0.64	0.09	0.08	2.28	9.24	35.47	n/s
6/4/2007 16:00	12:00	111.7	94.9	26.68	**13**	1.40	0.38	12.74	2.58	134.1	196.3	18.58	13.88	0.03	0.04	0.36	0.24	4.29	2.36	0.26	0.19	3.80	8.90	26.26	1.62
					13x	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
6/4/2007 17:00	13:00	260.9	221.7	27.25	**14**	1.01	0.17	6.92	0.06	134.7	174.2	18.00	15.40	0.02	0.02	0.19	0.01	4.31	2.09	0.25	0.22	3.67	8.96	31.20	n/s
					14x	n/s	n/s	n/s	n/s	n/s	275.4	26.89	24.29	n/s	n/s	n/s	n/s	n/s	3.31	0.38	0.34	n/s	n/s	n/s	n/s
6/4/2007 18:00	14:00	282.2	239.8	27.59	**15**	0.86	0.16	7.62	2.05	133.8	195.0	19.38	17.08	0.02	0.02	0.21	0.20	4.28	2.34	0.27	0.24	3.89	8.97	30.70	1.21
6/4/2007 19:00	15:00	266.3	226.2	27.55	**16**	0.57	0.16	8.02	0.05	130.0	218.9	19.58		0.01	0.02	0.22	0.00	4.16	2.63	0.27	0.25	3.63	8.96	30.23	n/s
6/4/2007 20:00	16:00	248.8	211.4	27.78	**17**	0.93	0.26	8.63	2.28	131.3	216.4	23.23	20.03	0.02	0.03	0.24	0.22	4.20	2.60	0.33	0.28	3.64	9.09	30.28	1.00
6/4/2007 21:00	17:00	175.6	149.2	28.05	**18**	1.01	0.31	8.02	0.07	133.4	219.8	23.02	19.32	0.02	0.03	0.22	0.01	4.27	2.64	0.32	0.27	10.34	8.62	29.52	1.12
6/4/2007 22:00	18:00	-26.1	-22.2	28.19	**19**	1.01	0.41	8.43	0.18	133.4	125.8	14.36	9.86	0.02	0.04	0.24	0.02	4.27	1.51	0.20	0.14	11.35	8.72	28.82	2.08
6/4/2007 23:00	19:00	-209.8	-178.3	27.85	**20**	0.54	0.01	0.53	0.62	134.1	51.7	8.57	7.81	0.01	0.00	0.01	0.06	4.29	0.62	0.12	0.11	5.66	8.85	36.55	0.30
6/5/2007 0:00	20:00	-292.6	-248.6	27.62	**21**	0.71	0.01	0.58	2.12	149.1	13.1	6.30	5.33	0.01	0.00	0.02	0.20	4.77	0.16	0.09	0.07	4.34	8.08	25.62	0.15
6/5/2007 1:00	21:00	-309.9	-263.4	27.42	**22**	0.68	0.02	0.55	0.12	149.4	11.7	6.05	5.00	0.01	0.00	0.02	0.01	4.78	0.14	0.08	0.07	5.29	7.43	36.21	0.17
6/5/2007 2:00	22:00	-305.8	-259.8	27.08	**23**	0.45	0.04	0.55	2.45	150.3	-6.3	6.31	5.41	0.01	0.00	0.02	0.23	4.81	-0.08	0.09	0.08	4.55	8.17	36.30	0.00
6/5/2007 3:00	23:00	-285.6	-242.7	26.93	**24**	0.54	0.02	0.49	0.21	151.3	14.8	7.32	6.51	0.01	0.00	0.01	0.02	4.84	0.18	0.10	0.09	4.35	7.81	36.23	n/s
					24x	n/s	n/s	n/s	n/s	n/s	1.7	7.21	6.51	n/s	n/s	n/s	n/s	n/s	0.02	0.10	0.09	n/s	n/s	n/s	n/s
6/5/2007 4:00	0:00	-151.0	-128.3	26.88	**25**	0.48	0.03	0.55	0.83	152.5	-8.2	6.34	5.51	0.01	0.00	0.02	0.08	4.88	-0.10	0.09	0.08	8.31	7.86	36.28	0.07
6/5/2007 5:00	1:00	227.0	192.9	26.96	**26**	1.17	0.36	15.35	0.88	156.3	88.0	12.99	8.69	0.02	0.04	0.43	0.08	5.00	1.06	0.18	0.12	13.90	7.81	28.69	n/s
6/5/2007 6:00	2:00	339.3	288.3	26.94	**27**	0.48	0.17	8.33	2.02	154.7	89.2	13.07	11.15	0.01	0.02	0.23	0.19	4.95	1.07	0.18	0.16	4.84	7.85	32.72	0.65
					27x	n/s	n/s	n/s	n/s	n/s	56.7	9.07	7.30	n/s	n/s	n/s	n/s	n/s	0.68	0.13	0.10	n/s	n/s	n/s	n/s
6/5/2007 7:00	3:00	319.0	271.0	26.98	**28**	0.86	0.16	5.82	0.75	152.5	66.0	10.48	8.18	0.02	0.02	0.16	0.07	4.88	0.79	0.15	0.11	9.50	7.76	32.02	n/s
6/5/2007 8:00	4:00	313.8	266.6	26.96	**29**	1.01	0.21	8.53	0.08	153.1	139.6	15.99	13.09	0.02	0.02	0.24	0.01	4.90	1.68	0.22	0.18	8.69	7.88	30.52	1.03
6/5/2007 9:00	5:00	261.4	222.1	26.97	**30**	1.32	0.35	11.23	0.78	154.4	152.1	17.78	13.38	0.02	0.04	0.31	0.07	4.94	1.82	0.25	0.19	6.00	7.79	29.57	n/s
6/5/2007 9:30	5:30	239.4	203.4	27.00	**31**	1.40	0.38	12.24	0.09	154.7	183.7	38.85	33.25	0.03	0.04	0.34	0.01	4.95	2.20	0.31	0.24	n/s	7.81	n/s	n/s
6/5/2007 10:00	6:00	194.6	165.3	27.04	**32**	1.32	0.36	19.76	0.10	156.9	112.7	15.19	10.69	0.02	0.04	0.55	0.01	5.02	1.35	0.21	0.15	8.82	7.79	28.99	1.58
6/5/2007 11:00	7:00	-45.7	-38.8	27.06	**33**	1.17	0.41	13.14	1.30	160.6	328.5	31.99	27.29	0.02	0.04	0.37	0.12	5.14	3.94	0.45	0.38	3.37	7.75	24.41	n/s
6/5/2007 12:00	8:00	-202.7	-172.2	26.68	**34**	0.44	0.07	0.00	0.03	150.3	143.7	11.84	10.73	0.01	0.01	0.00	0.00	4.81	1.72	0.17	0.15	6.67	7.85	36.40	0.17
6/5/2007 13:00	9:00	-274.0	-232.8	26.56	**35**	0.55	0.02	0.00	0.03	151.9	212.6	12.35	11.52	0.01	0.00	0.00	0.00	4.86	2.55	0.17	0.16	6.31	8.00	36.39	n/s
6/5/2007 14:00	10:00	-288.8	-245.4	26.58	**36**	0.54	0.04	0.00	0.01	150.3	13.9	6.64	5.62	0.01	0.00	0.00	0.00	4.81	0.17	0.09	0.08	4.71	8.00	36.34	0.24
					Blank		n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
6/5/2007 15:00	11:00	-252.6	-214.6	26.69	**37**	0.52	0.04	0.00	0.01	147.8	32.4	4.84	4.04	0.01	0.00	0.00	0.00	4.73	0.39	0.07	0.06	5.20	7.97	36.38	n/s
6/5/2007 16:00	12:00	-151.4	-128.6	26.84	**38**	0.60	0.06	0.00	0.02	139.1	21.0	3.38	2.16	0.01	0.01	0.00	0.00	4.45	0.25	0.05	0.03	4.59	7.96	36.43	0.35
6/5/2007 17:00	13:00	115.2	97.9	27.17	**39**	0.64	0.12	13.24	0.04	129.7	324.5	17.28	15.54	0.01	0.01	0.37	0.00	4.15	3.89	0.24	0.22	8.29	7.99	27.79	n/s
6/5/2007 18:00	14:00	251.9	214.1	27.66	**40**	0.52	0.05	6.02	0.01	133.8	152.9	10.34	9.26	0.01	0.01	0.17	0.00	4.28	1.83	0.14	0.13	7.85	7.72	32.16	n/s
					40x	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	0.75
6/5/2007 19:00	15:00	269.9	229.3	27.97	**41**	0.78	0.06	5.82	0.01	139.4	207.6	11.70	10.22	0.01	0.01	0.16	0.00	4.46	2.49	0.16	0.14	11.43	7.76	31.52	n/s
6/5/2007 20:00	16:00	257.0	218.4	27.77	**42**	0.48	0.02	7.82	0.01	138.8	242.4	10.99	10.25	0.01	0.00	0.22	0.00	4.44	2.91	0.15	0.14	7.58	7.71	30.05	1.70
					42x	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	1.56
6/5/2007 21:00	17:00	216.8	184.2	27.86	**43**	0.59	0.04	6.72	0.01	141.3	239.8	16.27	15.19	0.01	0.00	0.19	0.00	4.52	2.88	0.23	0.21	9.42	7.69	28.67	n/s
6/5/2007 22:00	18:00	172.1	146.2	27.80	**44**	0.54	0.07	8.83	0.01	141.3	371.7	9.93	8.68	0.01	0.01	0.25	0.00	4.52	4.46	0.14	0.12	10.14	7.68	28.27	2.27
6/5/2007 23:00	19:00	-85.0	-72.2	27.59	**45**	1.17	0.23	11.44	1.89	151.6	324.4	12.37	9.07	0.02	0.03	0.32	0.18	4.85	3.89	0.17	0.13	14.11	7.65	26.95	n/s
6/6/2007 0:00	20:00	-207.4	-176.2	27.02	**46**	1.17	0.12	0.08	1.04	148.4	224.3	16.35	13.96	0.02	0.01	0.00	0.10	4.75	2.69	0.23	0.20	12.99	7.65	35.53	0.41
6/6/2007 1:00	21:00	-282.2	-239.8	26.63	**47**	1.09	0.09	0.00	0.09	150.9	323.3	5.86	3.78	0.02	0.01	0.00	0.01	4.83	3.88	0.08	0.05	5.81	7.65	34.77	n/s
					47x	n/s	n/s	n/s	n/s	n/s	129.4	14.54	12.14	n/s	n/s	n/s	n/s	n/s	1.55	0.20	0.17	n/s	n/s	n/s	n/s
6/6/2007 2:00	22:00	-318.3	-270.4	26.39	**48**	0.86	0.06	0.00	0.85	153.4	285.6	9.79	8.23	0.02	0.01	0.00	0.08	4.91	3.43	0.14	0.12	9.15	7.60	35.01	0.22
6/6/2007 3:00	23:00	-326.4	-277.4	26.46	**49**	0.75	0.06	1.10	2.09	149.7	239.4	6.95	5.49	0.01	0.01	0.03	0.20	4.79	2.87	0.10	0.08	6.76	7.57	35.45	0.24
6/6/2007 4:00	0:00	-265.4	-225.5	26.51	**50**	0.75	0.09	3.21	2.71	150.0	175.3	6.13	4.48	0.01	0.01	0.09	0.26	4.80	2.10	0.09	0.06	11.56	7.50	35.06	0.41
					50x	n/s	n/s	n/s	n/s	n/s	130.4	6.35	4.75	0.06	0.06	0.55	0.26	n/s	1.57	0.09	0.07	n/s	n/s	n/s	n/s
					Blank	0.00	0.00	0.00	0.36			n/s	n/s	0.00	0.00	0.00	0.03	n/s	n/s	n/s	n/s	n/s	n/s	n/s	1.36

Appendix II. Nutrient results from the September 2007 Sampling Intensive (page 1).

Date/Time	Time	Flow	Flow	Temp	Sample	NH_4	NO_2+NO_3	Si	PO_4	DO	TDP			^{15}N	NH_4	NO_2+NO_3	Si	PO_4	DO	TOP		TSS	pH	Salinity	Turbitity
GMT	EDT	[m^3/sec]	corr.	[^oC]	Number	µM	µM	µM	µM	µM	µM			‰	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L		ppt	NTU
9/26/2007 19:00	15:00	130.7	111.1	28.15	**1**	7.807	7.33	36.39	0.59	234.7	n/s			-4.30	0.14	0.13	1.02	0.06	7.51	n/s		3.22	7.51	17.19	0.73
	BLANK				**2**	0.556	0.00	0.00	0.00	n/a	n/s			n/s	0.01	0.00	0.00	0.00	n/s	n/s		n/s	n/s	n/s	n/s
					3	n/s	n/s	n/s	n/s	n/s	n/s			n/s	n/s	n/s	n/s	n/s	n/s	n/s		5.41	n/s	n/s	0.24
9/26/2007 20:00	16:00	-115.2	-97.9	28.32	**4**	1.237	1.01	4.29	0.06	140.0	n/s			19.38	0.02	0.02	0.12	0.01	4.48	n/s		2.34	8.08	36.87	0.03
9/26/2007 21:00	17:00	-226.6	-192.6	28.48	**5**	0.734	0.65	2.71	0.03	141.9	n/s			n/s	0.01	0.01	0.08	0.00	4.54	n/s		1.96	8.08	37.57	0.00
9/26/2007 22:00	18:00	-253.4	-215.3	28.75	**6**	0.576	0.57	1.71	0.02	137.8	n/s			7.83	0.01	0.01	0.05	0.00	4.41	n/s		1.50	8.08	38.26	0.01
9/26/2007 23:00	19:00	-252.3	-214.3	28.70	**7**	0.466	0.61	1.00	0.01	135.3	n/s			n/s	0.01	0.01	0.03	0.00	4.33	n/s		0.76	8.03	38.59	0.13
9/27/2007 0:00	20:00	-195.1	-165.8	28.71	**8**	0.476	0.45	0.54	0.00	142.5	n/s			2.44	0.01	0.01	0.02	0.00	4.56	n/s		1.78	8.29	38.97	0.00
9/27/2007 1:00	21:00	-26.0	-22.1	28.75	**9**	0.463	0.47	0.61	0.00	140.3	n/s			n/s	0.01	0.01	0.02	0.00	4.49	n/s		1.90	8.13	38.81	0.00
9/27/2007 1:30	21:30	165.3	140.4	28.50	**10**	6.774	5.83	34.71	0.62	159.4	n/s			-4.62	0.12	0.11	0.97	0.06	5.10	n/s		3.69	7.99	22.66	0.43
9/27/2007 2:00	22:00	265.6	225.7	28.26	**11a**	6.256	6.77	39.21	1.01	164.7	3.43			n/s	0.11	0.12	1.10	0.10	5.27	0.33		3.91	7.90	22.38	0.55
					11b	5.889	6.28	36.10	0.88	164.1	2.81			n/s	0.11	0.11	1.01	0.08	5.25	0.11		4.12	7.90	21.66	0.59
					11c	6.722	5.67	31.71	0.68	166.6	2.70			n/s	0.12	0.10	0.89	0.07	5.33	0.60		3.56	7.88	20.17	0.08
9/27/2007 2:30	22:30	321.3	273.0	27.94	**12**	6.180	6.30	36.11	0.88	165.0	n/s			-8.19	0.11	0.11	1.01	0.08	5.28	n/s		4.91	7.86	20.19	1.61
9/27/2007 3:00	23:00	340.8	289.5	27.89	**13**	0.609	6.22	36.89	0.78	164.7	n/s			n/s	0.01	0.11	1.03	0.07	5.27	n/s		4.40	7.85	20.50	1.29
9/27/2007 3:30	23:30	304.9	259.0	27.98	**14**	6.603	6.77	29.11	0.59	160.0	n/s			-1.96	0.12	0.12	0.82	0.06	5.12	n/s		5.92	7.86	22.27	0.79
9/27/2007 4:00	0:00	315.1	267.7	28.11	**15**	6.549	5.52	36.61	0.78	164.7	n/s			n/s	0.12	0.10	1.03	0.07	5.27	n/s		3.68	7.82	19.85	0.00
					15x	8.580	6.67	35.79	0.75	167.5	n/s			n/s	0.12	0.12	1.00	0.07	5.36	n/s		6.40	7.82	19.91	0.35
	BLANK				**16**	0.778	0.78	0.00	0.02	n/s	n/s			n/s	0.01	0.01	0.00	0.00	n/s	n/s		n/s	n/s	n/s	n/s
9/27/2007 4:30	0:30	318.5	270.6	28.21	**17**	5.206	4.28	24.89	0.45	158.8	n/s			0.06	0.09	0.08	0.70	0.04	5.08	n/s		4.13	7.90	25.19	0.83
9/27/2007 5:00	1:00	303.0	257.5	28.29	**18**	6.804	5.52	33.39	0.62	161.6	n/s			n/s	0.12	0.10	0.94	0.06	5.17	n/s		4.03	7.87	22.01	0.83
9/27/2007 5:30	1:30	290.8	247.1	28.26	**19**	7.344	5.52	33.46	0.59	162.8	n/s			-4.98	0.13	0.10	0.94	0.06	5.21	n/s		4.97	7.83	21.17	1.77
9/27/2007 6:00	2:00	271.9	231.0	28.17	**20**	7.170	5.60	34.50	0.62	163.1	n/s			n/s	0.13	0.10	0.97	0.06	5.22	n/s		4.76	7.82	21.95	1.02
9/27/2007 6:30	2:30	245.1	208.2	28.10	**21**	8.621	5.44	34.61	0.62	165.9	n/s			-4.46	0.16	0.10	0.97	0.06	5.31	n/s		5.51	7.70	18.33	1.06
9/27/2007 7:00	3:00	201.8	171.5	28.00	**22**	8.673	7.78	49.71	1.04	175.6	n/s			n/s	0.16	0.14	1.39	0.10	5.62	n/s		4.74	7.70	16.50	1.59
9/27/2007 8:00	4:00	-15.1	-12.8	28.05	**23**	8.700	8.01	52.89	0.95	175.0	n/s			n/s	0.16	0.14	1.48	0.09	5.60	n/s		3.71	7.67	15.36	1.06
9/27/2007 9:00	5:00	-201.1	-170.9	28.59	**24**	1.201	0.72	0.82	0.07	143.8	n/s			3.47	0.02	0.01	0.02	0.01	4.60	n/s		1.67	8.09	38.95	0.08
9/27/2007 10:00	6:00	-249.1	-211.6	28.67	**25**	0.611	0.86	0.11	0.03	148.4	n/s			n/s	0.01	0.02	0.00	0.00	4.75	n/s		1.60	8.13	39.34	0.00
9/27/2007 11:00	7:00	-279.7	-237.6	28.74	**26**	0.443	0.74	0.00	0.02	145.6	n/s			3.20	0.01	0.01	0.00	0.00	4.66	n/s		1.94	8.14	37.60	0.00
9/27/2007 12:00	8:00	-264.4	-224.7	28.68	**27**	0.666	0.64	0.00	0.01	139.1	n/s			n/s	0.01	0.01	0.00	0.00	4.45	n/s		2.66	8.13	38.44	0.21
9/27/2007 13:00	9:00	-182.9	-155.4	28.73	**28**	0.363	0.39	0.61	0.02	132.2	n/s			n/s	0.01	0.01	0.02	0.00	4.23	n/s		1.32	8.13	39.18	0.06
9/27/2007 13:30	9:30	-59.5	-50.6	28.84	**29**	0.373	0.18	0.00	0.01	135.6	n/s			-0.44	0.01	0.00	0.00	0.00	4.34	n/s		2.08	8.14	39.45	0.00
9/27/2007 14:00	10:00	187.5	159.3	28.67	**30a**	8.576	6.07	36.71	0.39	164.1	2.64			n/s	0.15	0.11	1.03	0.04	5.25	1.44		3.96	7.81	17.68	1.15
					30b	8.500	5.78	34.29	0.42	162.2	2.70			n/s	0.15	0.10	0.96	0.04	5.19	1.40		3.58	7.82	17.70	1.19
					30c	10.930	6.56	37.11	0.49	159.4	2.61			n/s	0.15	0.12	1.04	0.05	5.10	1.11		3.30	7.86	18.21	1.51
9/27/2007 14:30	10:30	278.4	236.6	28.05	**31**	7.349	5.91	35.61	0.53	159.4	n/s			-3.45	0.13	0.11	1.00	0.05	5.10	n/s		3.11	7.85	21.31	1.42
9/27/2007 15:00	11:00	326.8	277.7	27.86	**32**	7.255	4.67	27.89	0.39	158.4	n/s			n/s	0.13	0.08	0.78	0.04	5.07	n/s		3.69	7.84	21.42	1.24
9/27/2007 15:30	11:30	329.8	280.2	27.87	**33**	7.289	4.90	28.79	0.45	160.9	n/s			-0.11	0.13	0.09	0.81	0.04	5.15	n/s		4.80	7.86	21.91	1.08
9/27/2007 16:00	12:00	325.6	276.7	28.08	**34**	5.868	4.82	27.61	0.39	155.6	n/s			n/s	0.11	0.09	0.77	0.04	4.98	n/s		4.84	7.88	22.96	1.16
					34x	5.778	4.89	28.00	0.39	n/s	n/s			n/s	0.10	0.09	0.78	0.04	n/s	n/s		3.20	n/s	n/s	0.90
					35	0.944	0.00	0.00	0.02	n/s	n/s			n/s	0.02	0.00	0.00	0.00	n/s	n/s		n/s	n/s	n/s	n/s
9/27/2007 16:30	12:30	319.5	271.5	28.26	**36**	6.167	4.90	26.89	0.29	153.8	n/s			-1.76	0.11	0.09	0.75	0.03	4.92	n/s		4.97	7.88	22.51	1.65
9/27/2007 17:00	13:00	332.3	282.4	28.43	**37**	4.998	4.67	26.11	0.32	148.1	n/s			n/s	0.09	0.08	0.73	0.03	4.74	n/s		4.91	7.87	21.62	1.69
9/27/2007 17:30	13:30	312.1	265.2	28.54	**38**	6.040	4.12	22.61	0.33	148.8	n/s			1.00	0.11	0.07	0.63	0.03	4.76	n/s		4.66	7.92	24.31	0.79
9/27/2007 18:00	14:00	281.4	239.1	28.58	**39**	3.335	4.36	23.61	0.31	144.4	n/s			n/s	0.06	0.08	0.66	0.03	4.62	n/s		3.96	7.95	23.46	1.15
9/27/2007 18:30	14:30	258.1	219.3	28.64	**40**	3.251	4.20	22.50	0.29	143.8	n/s			-0.93	0.06	0.08	0.63	0.03	4.60	n/s		4.32	7.96	22.85	0.64
9/27/2007 19:00	15:00	227.6	193.4	28.69	**41**	3.118	4.74	23.61	0.33	144.1	n/s			n/s	0.06	0.09	0.66	0.03	4.61	n/s		3.89	7.92	21.96	2.52
9/27/2007 19:30	15:30	190.9	162.2	28.76	**42**	8.161	6.53	30.89	0.49	149.1	n/s			-3.56	0.15	0.12	0.87	0.05	4.77	n/s		1.93	7.83	21.54	0.98
9/27/2007 20:30	16:30	-44.2	-37.5	28.78	**43**	8.017	7.70	36.61	0.59	148.4	n/s			n/s	0.14	0.14	1.03	0.06	4.75	n/s		3.54	7.82	20.48	0.89
9/27/2007 21:30	17:30	-200.4	-170.3	29.35	**44**	0.568	0.47	1.21	0.06	129.1	n/s			2.30	0.01	0.01	0.03	0.01	4.13	n/s		2.07	8.11	38.49	0.29
9/27/2007 21:30	17:30	-200.4	-170.3	29.35	**44x**	n/s	n/s	n/s	n/s	146.3	n/s			n/s	n/s	n/s	n/s	n/s	4.68	n/s		3.20	7.73	37.09	n/s
9/27/2007 22:30	18:30	-248.6	-211.3	29.29	**45**	0.308	0.16	0.00	0.09	132.5	n/s			n/s	0.01	0.00	0.00	0.01	4.24	n/s		1.88	7.75	37.51	0.34
9/27/2007 23:30	19:30	-272.1	-231.2	29.17	**46**	0.371	0.33	0.86	0.04	153.1	n/s			-6.90	0.01	0.01	0.02	0.00	4.90	n/s		1.04	7.84	36.91	0.17
9/28/2007 0:30	20:30	-234.6	-199.4	29.04	**47**	0.496	0.53	1.50	0.05	143.8	n/s			n/s	0.01	0.01	0.04	0.01	4.60	n/s		1.70	7.87	36.52	0.31
9/28/2007 1:30	21:30	-115.9	-98.5	29.10	**48**	0.370	0.33	0.64	0.02	171.3	n/s			-6.13	0.01	0.01	0.02	0.00	5.48	n/s		1.70	7.91	37.03	0.34

Appendix II. Nutrient results from the September 2007 Sampling Intensive (page 2).

Date/Time	Time	Flow	Flow	Temp	Sample	NH_4	NO_2+NO_3	Si	PO_4	DO	TDP			^{15}N	NH_4	NO_2+NO_3	Si	PO_4	DO	TOP		TSS	pH	Salinity	Turbitity
GMT	EDT	[m^3/sec]	corr.	[^oC]	Number	µM	µM	µM	µM	µM	µM			‰	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L		ppt	NTU
9/28/2007 2:00	22:00	32.0	27.2	29.15	**49**	0.497	0.51	1.29	0.07	150.0	n/s			n/s	0.01	0.01	0.04	0.01	4.80	n/s		2.82	7.91	36.59	0.32
9/28/2007 2:30	22:30	203.0	172.4	28.94	**50**	3.012	3.81	19.29	0.28	149.7	n/s			-2.69	0.05	0.07	0.54	0.03	4.79	n/s		2.90	7.80	25.07	0.69
9/28/2007 3:00	23:00	270.4	229.7	28.68	**51a**	2.622	3.66	17.21	0.24	126.6	1.21			n/s	0.05	0.07	0.48	0.02	4.05	0.46		3.38	7.81	23.78	0.77
					51b	2.556	3.78	17.50	0.26	142.5	1.15			n/s	0.05	0.07	0.49	0.03	4.56	0.35		3.43	7.82	23.79	0.64
					51c	2.444	3.06	12.61	0.25	150.3	1.07			n/s	0.04	0.06	0.35	0.02	4.81	0.31		3.11	7.85	27.69	0.47
9/28/2007 3:30	23:30	259.9	220.9	28.67	**52**	1.773	2.41	8.61	0.18	168.8	n/s			0.90	0.03	0.04	0.24	0.02	5.40	n/s		3.94	7.93	26.81	0.87
9/28/2007 4:00	0:00	271.7	230.8	28.61	**53**	1.515	1.79	4.89	0.13	160.9	n/s			n/s	0.03	0.03	0.14	0.01	5.15	n/s		3.88	7.87	26.09	1.38
					53x	1.500	2.28	6.21	0.16	n/s	n/s			n/s	0.03	0.04	0.17	0.02	n/s	n/s		n/s	n/s	n/s	0.67
					54	1.000	0.00	0.00	0.01	n/s	n/s			n/s	0.02	0.00	0.00	0.00	n/s	n/s		n/s	n/s	n/s	n/s
9/28/2007 4:30	0:30	286.2	243.2	28.65	**55**	1.975	2.49	11.61	0.49	165.3	n/s			-0.22	0.04	0.04	0.33	0.02	5.29	n/s		5.00	7.88	25.45	0.64
9/28/2007 5:00	1:00	286.6	243.6	28.72	**56**	2.362	2.41	12.39	0.54	149.7	n/s			n/s	0.04	0.04	0.35	0.02	4.79	n/s		4.40	7.83	25.34	0.86
9/28/2007 5:30	1:30	304.9	259.1	28.74	**57**	2.643	2.64	17.21	0.51	147.5	n/s			0.44	0.05	0.05	0.48	0.02	4.72	n/s		4.32	7.81	22.64	0.89
9/28/2007 6:00	2:00	277.6	235.9	28.67	**58**	3.340	2.57	13.79	0.61	144.4	n/s			n/s	0.06	0.05	0.39	0.02	4.62	n/s		3.54	7.83	26.95	0.83
9/28/2007 6:30	2:30	261.3	222.1	28.65	**59**	3.835	4.04	20.21	0.83	141.6	n/s			-3.41	0.07	0.07	0.57	0.03	4.53	n/s		3.55	7.80	23.20	1.13
9/28/2007 7:00	3:00	249.6	212.1	28.61	**60**	5.055	4.51	21.79	1.00	118.8	n/s			n/s	0.09	0.08	0.61	0.03	3.80	n/s		3.43	7.76	24.68	0.58
9/28/2007 7:30	3:30	214.1	181.9	28.61	**61**	5.481	5.83	26.79	1.40	139.7	n/s			-4.41	0.10	0.11	0.75	0.04	4.47	n/s		4.19	7.74	22.53	0.78
9/28/2007 8:00	4:00	157.7	134.0	28.59	**62**	5.496	6.22	27.61	1.30	124.4	n/s			n/s	0.10	0.11	0.77	0.04	3.98	n/s		4.16	7.72	22.34	0.77
9/28/2007 9:00	5:00	-93.9	-79.8	28.57	**63**	4.131	3.81	17.11	1.10	138.8	n/s			n/s	0.07	0.07	0.48	0.03	4.44	n/s		2.91	7.83	28.43	0.68
9/28/2007 10:00	6:00	-214.9	-182.6	28.91	**64**	0.676	0.44	0.00	0.06	112.8	n/s			8.93	0.01	0.01	0.00	0.00	3.61	n/s		1.57	7.93	37.82	0.31
9/28/2007 11:00	7:00	-254.7	-216.4	29.13	**65**	0.439	0.31	0.00	0.04	130.0	n/s			n/s	0.01	0.01	0.00	0.00	4.16	n/s		n/s	7.95	38.08	0.47
9/28/2007 12:00	8:00	-290.0	-246.4	29.11	**66**	0.318	0.12	0.00	0.04	144.7	n/s			n/s	0.01	0.00	0.00	0.00	4.63	n/s		1.78	7.98	37.85	0.55
9/28/2007 13:00	9:00	-268.6	-228.2	28.92	**67**	0.331	0.35	0.00	0.05	143.4	n/s			n/s	0.01	0.01	0.00	0.00	4.59	n/s		1.68	7.99	37.32	0.23
9/28/2007 14:00	10:00	-173.8	-147.7	28.94	**68**	0.380	0.28	0.00	0.04	104.7	n/s			-5.23	0.01	0.01	0.00	0.00	3.35	n/s		1.11	7.91	37.45	0.43
9/28/2007 14:30	10:30	-43.6	-37.1	29.10	**69**	0.521	0.19	0.00	0.04	143.8	n/s			8.27	0.01	0.00	0.00	0.00	4.60	n/s		2.26	7.95	37.39	0.23
					69x	n/s	n/s	n/s	n/s	n/s	n/s			n/s	n/s	n/s	n/s	n/s	n/s	n/s		n/s	n/s	n/s	n/s
9/28/2007 15:00	11:00	195.8	166.4	28.96	**70a**	1.860	3.66	20.50	0.42	187.8	1.15			n/s	0.03	0.07	0.57	0.01	6.01	0.73		2.91	7.94	23.31	1.02
					70b	1.889	1.22	16.61	0.50	151.9	1.18			n/s	0.03	0.02	0.47	0.02	4.86	0.68		3.01	7.94	26.12	1.14
					70c	3.222	0.72	20.00	0.58	150.0	0.97			n/s	0.06	0.01	0.56	0.02	4.80	0.39		1.97	7.94	26.41	1.24
9/28/2007 15:30	11:30	247.2	210.0	28.84	**71**	1.004	1.01	8.00	0.24	162.2	n/s			3.76	0.02	0.02	0.22	0.01	5.19	n/s		3.19	7.64	30.80	1.09
9/28/2007 16:00	12:00	247.7	210.4	28.98	**72**	0.575	0.51	7.89	0.18	160.9	n/s			n/s	0.01	0.01	0.22	0.01	5.15	n/s		4.65	7.73	29.22	0.81
					72x	0.611	0.56	9.11	0.24	n/s	n/s			n/s	0.01	0.01	0.26	0.01	n/s	n/s		n/s	n/s	n/s	0.84
					73	n/s	n/s	n/s	n/s	n/s	n/s			n/s	n/s	n/s	n/s	n/s	n/s	n/s		n/s	n/s	n/s	n/s
9/28/2007 16:30	12:30	280.4	238.3	29.11	**74**	0.497	0.27	5.71	0.15	176.3	n/s			1.27	0.01	0.00	0.16	0.01	5.64	n/s		4.03	7.95	29.29	1.16
9/28/2007 17:00	13:00	259.5	220.5	29.19	**75**	0.456	0.17	3.21	0.10	191.3	n/s			n/s	0.01	0.00	0.09	0.00	6.12	n/s		4.30	7.99	28.73	1.51
9/28/2007 17:30	13:30	217.2	184.6	29.26	**76**	0.469	0.26	4.79	0.11	198.4	n/s			7.01	0.01	0.00	0.13	0.00	6.35	n/s		5.00	7.99	27.13	1.49
9/28/2007 18:00	14:00	302.4	256.9	29.35	**77**	0.521	0.32	4.71	0.05	210.6	n/s			n/s	0.01	0.01	0.13	0.00	6.74	n/s		4.47	7.94	27.13	1.34
9/28/2007 18:30	14:30	262.2	222.8	29.55	**78**	0.597	0.33	6.11	0.10	202.5	n/s			7.91	0.01	0.01	0.17	0.00	6.48	n/s		4.57	8.05	27.62	1.84
					78x	n/s	n/s	n/s	n/s	n/s	n/s			n/s	n/s	n/s	n/s	n/s	n/s	n/s		n/s	n/s	n/s	n/s
9/28/2007 19:00	15:00	277.8	236.0	29.72	**79**	0.600	0.74	9.89	0.13	210.6	n/s			n/s	0.01	0.01	0.28	0.00	6.74	n/s		4.47	8.01	26.08	1.52
9/28/2007 19:30	15:30	264.3	224.6	29.92	**80**	1.493	2.18	15.39	0.33	182.5	n/s			5.66	0.03	0.04	0.43	0.01	5.84	n/s		-0.47	7.97	25.66	1.4
9/28/2007 20:00	16:00	233.8	198.7	30.00	**81**	1.994	2.41	15.29	0.39	169.4	n/s			n/s	0.04	0.04	0.43	0.01	5.42	n/s		3.97	7.97	25.37	1.6
9/28/2007 20:30	16:30	197.4	167.8	30.06	**82**	1.623	2.49	16.00	0.40	177.8	n/s			n/s	0.03	0.04	0.45	0.01	5.69	n/s		4.54	8.03	24.14	1.55
9/28/2007 21:00	17:00	127.4	108.2	30.13	**83**	1.719	3.19	17.11	0.47	155.6	n/s			n/s	0.03	0.06	0.48	0.02	4.98	n/s		4.71	7.96	24.47	1.39
					84	1.222	3.19	0.00	0.11	n/s	n/s			n/s	0.02	0.06	0.00	0.00	n/s	n/s		-0.10	n/s	n/s	-0.17

Appendix III. June Intensive Microbiological results.

Microbiology results are shown in Table 1 a-b for the June intensive. These represent two continuous sampling periods, broken into time segments. Tables are colorized to reflect either incoming (blue) or outgoing (yellow) tidal flow.

Table 1a June 4 Microbial Water Quality of Incoming and Outgoing Tides

	Assay	6/4/2007													
		0030	0100	0230	0400	0500	0600	0800	1000	1200	1400	1600	1800	2000	2200
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	31	31	10	10	63	51	<10	<1	10	<10	10	10	10	<10
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	31	141	87	189	122	165	20	31	36	20	20	81	20	50
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	1495	6586	6488	8664	12997	8664	1725	110	7270	5475	7270	1199	4160	1396
	Presence of **Human-source Enterococci** by PCR (esp gene marker	nd	nd	nd	+	nd	nd	nd	-	nd	nd	-	nd	nd	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	nd	nd	nd	-	nd	nd	nd	-	nd	nd	-	nd	nd	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	nd	nd	nd	+	nd	nd	nd	-	nd	nd	-	nd	nd	-
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	nd	nd	nd	-	nd	nd	nd	-	nd	nd	-	nd	nd	-
	E. coli O157:H7 (rfb gene)	nd	nd	nd	-	nd	nd	nd	-	nd	nd	-	nd	nd	-
	Campylobacter jejuni (HipO gene)	nd	nd	nd	-	nd	nd	nd	-	nd	nd	-	nd	nd	-
	Staphylococcus aureus (clfA gene)	nd	nd	nd	+	nd	nd	nd	-	nd	nd	-	nd	nd	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6.3	nd	nd	<1
	Giardia cysts (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	4.2	nd	nd	<1
Presence of Human viruses (by PCR)	**Human Adenovirus**	nd	nd	nd	+	nd	nd	nd	-	nd	nd	-	nd	nd	+
	Noroviruses	nd	nd	nd	+	nd	nd	nd	-	nd	nd	-	nd	nd	-
	Enteroviruses	nd	nd	nd	-	nd	nd	nd	-	nd	nd	-	nd	nd	-

= outgoing tide
= incoming tide

nd = "not determined"

Table 1b June 5 Microbial Water Quality of Incoming and Outgoing Tides

	Assay	6/5/2007													6/6/2007
		0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2300	0000
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	<10	10	20	10	<10	<10	<10	10 10	10	10	<10	<10	<10	10 <10
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	20	20	20	30	20	30	10	60 30	30	82	86	30	61	30 51
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	738	5475	6130	7701	2755	3255	1050	5475 4106	6131	8664	3873	1046	663	987 1014
	Presence of **Human-source Enterococci** by PCR (esp gene marker	nd	nd	+	nd	nd	-	nd	nd	-	nd	nd	-		nd
	Presence of **Human-source Bacteroides** HF8 marker by PCR	nd	nd	+	nd	nd		nd	nd		nd	nd			nd
	Presence of **Human-source Bacteroides** HuBac marker by PCR	nd	nd	+	nd	nd	-	nd	nd	+	nd	nd	+		nd
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	nd	nd	-	nd	nd	-	nd	nd	-	nd	nd	-		nd
	E. coli O157:H7 (rfb gene)	nd	nd	-	nd	nd	-	nd	nd	-	nd	nd	-		nd
	Campylobacter jejuni (HipO gene)	nd	nd	-	nd	nd	-	nd	nd	-	nd	nd	-		nd
	Staphylococcus aureus (clfA gene)	nd	nd	+	nd	nd	-	nd	nd	-	nd	nd	-		nd
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	nd	2.4	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd
	Giardia cysts (per 100 L)	nd	nd	1.2	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	nd	nd	-	nd	nd	-	nd	nd	+	nd	nd	-		nd
	Noroviruses	nd	nd	-	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd
	Enteroviruses	nd	nd	+	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd

Appendix IV. September Intensive Microbiological results.

The following data tables (Table 1a-g) summarize data elements common to both 48 hour intensive sampling periods at Boynton Inlet. Two duplicate tables were created showing the two principal concentration units mg/L and µM. Please note however that some data elements may be present for in one sampling period, and missing in the other. “ns” denotes not sampled, “na” denotes not available. Phosphate measurements were obtained during the June Intensive but are not shown because of possible contamination of the samples. Total Organic Nitrogen was not included in September tables due to a breakdown of the analytical system at FAU. Nitrogen isotope ratio analysis was only done in the September sampling period.

Table 1a. Microbial Water Quality of Incoming and Outgoing Tides (September 26-27):

		9/26/2007													
	Assay	1500	1600	1700	1800	1900	2000	2100	2130	2200-A	2200-B	2200-C	2230	2300	2330
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	223	20	10	<10	<10	10	10	196	155	321	235	114	245	384
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	622	1727	1296	1842	459	60	439	618	1077	1243	1153	1212	397	805
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	24196	9804	3255	5794	3255	2142	3255	19863	>24196	19863	24196	15531	17329	15531
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	-	-		-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	-	-		-	-	-	-	-	-	-	+	-	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	-	-	-		-	-	-	-	+	+	+	+	+	+
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-		-	-	-	-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-		-	-	-	-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-		-	-	-	-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	-		-	-	-	-	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	<1	nd		nd	nd	nd	nd	nd	2.6	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	<1	nd		nd	nd	nd	nd	nd	5.4	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	-	-	nd		nd	-	-	+	+	+	+	-	-	-
	Noroviruses	nd	-	nd		nd	-	nd	-	nd	-	nd	nd	nd	nd
	Enteroviruses	nd	-	nd		nd	-	nd	+	nd	-	nd	nd	nd	nd

= outgoing tide
= incoming tide

nd = "not determined"
*value exceeds EPA regulatory limit of 105 MPN/100 mL

Table 1b. 0000 hours through 0930 hours, September 27

	Assay	9/27/2007													
		0000	0030	0100	0130	0200	0230	0300	0400	0500	0600	0700	0800	0900	0930
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	335 163	95	103	166	95	84	152	126	41	<10	41	41	<10	10
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	724 414	645	537	425	417	362	474	320	324	497	185	86	94	71
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	19863 >24196	14136	>24196	24196	14136	12033	15531	12997	3654	3130	1670	1012	1396	2098
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	-	-	-	+	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	+	-	-	-	+	-	+	+	-	-	-	-	-	+
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	<1	nd	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	<1	nd	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	-	-	-	-	+	+	-	+	-	nd	-	-	-	-
	Noroviruses	-	nd	nd	nd	nd	nd	-	nd	-	nd	nd	-	nd	+
	Enteroviruses	-	nd	nd	nd	nd	nd	+	nd	-	nd	nd	-	nd	-

Table 1c. September 27, 1000 hours through 1530 hours

	Assay	9/27/2007													
		1000-A	1000-B	1000-C	1030	1100	1130	1200	1230	1300	1330	1400	1430	1500	1530
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	101	71	183	152	134	176	254 280	237	246	183	152	266	141	138
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	259	207	153	363	512	364	780 866	573	633	958	395	651	312	337
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	1199	15531	10462	6586	8164	10432	15531 12997	3151	3151	15531	12997	7701	8164	9804
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	-	-	-	-	-		-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	-	-	-	-	-		-	-	-	-	-	-	+
	Presence of **Human-source Bacteroides** HuBac marker by PCR	+	+	+	-	-	-		-	-	+	-	+		+
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-	-	-	-		-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-	-	-	-		-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-	-	-	-		-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	-	-	-	-		-	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	1.2	nd	nd	nd	d		nd	nd	nd	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	<1	nd	nd	nd	d		nd	nd	nd	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	+	+	-	-	-	-		-	-	-	-	-	-	+
	Noroviruses	nd	-	nd	nd	nd	d		-	nd	nd	nd	nd	nd	-
	Enteroviruses	nd	-	nd	nd	nd	d		-	nd	nd	nd	nd	nd	-

Table 1d. September 27, 1630 hours through September 28, 0030 hours.

	Assay	9/27/2007												9/28/2007	
		1630	1730	1830	1930	2030	2130	2200	2230	2300-A	2300-B	2300-C	2330	0000	0030
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	120	52	<10	10	41	10	<10	41	20	31	41	51	20 10	20
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	363	333	206	324	166	1057	976	560	474	747	1050	496	375 260	604
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	12033	5172	2098	2613	2595	5172	7270	11199	9208	12997	9804	8664	11199 10462	12033
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	-	-	-	-	-	-	-	+	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	-	-	-	-	-	-	+	+	+	-	-	+	-	-
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-	-	-	-	+	-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	<1	nd	nd	nd	nd	nd	nd	<1	nd	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	<1	nd	nd	nd	nd	nd	nd	15.2	nd	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Noroviruses	nd	-	nd	nd	-	nd	+	nd	+	nd	nd	nd	nd	nd
	Enteroviruses	nd	-	nd	nd	-	nd	-	nd	+	nd	nd	nd	nd	nd

Table 1f. September 28, 0100 hours through 1030 hours.

	Assay	9/28/2007													
		0100	0130	0200	0230	0300	0330	0400	0500	0600	0700	0800	0900	1000	1030
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	50	51	155	156	256	250	474	95	10	20	30	<10	<10	20 10
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	465	491	1077	1254	3026	3578	3088	896	893	705	474	350	325	2381 7270
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	12997	15531	11199	14136	15531	17329	15531	10462	5172	7270	24196	4352	4106	9208 9804
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	-	-	+	+	-	-	-	-	-	-	-	-	-	-
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	<1	nd	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	nd	nd	nd	nd	nd	nd	nd	<1	nd	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	+	+	-	-	-	-	-	-	-	-	-	-	-	+
	Noroviruses	-	nd	nd	nd	nd	nd	-	nd	-	nd	nd	-	nd	+
	Enteroviruses	-	nd	nd	nd	nd	nd	-	nd	-	nd	nd	-	nd	+

Table 1g. September 28, 1100 hours through 1700 hours.

	Assay	9/28/2007														
		1100-A	1100-B	1100-C	1130	1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	1700
Fecal Indicator Bacteria	**viable enterococci** by IDEXX EnteroLert, MPN/100 mL	10	10	40	30	31 20	41	41	10	20	20 20	10	20	20	10	10 < 10
	viable E. coli by IDEXX EnteroLert, MPN/100 mL	4160	1495	2427	2700	2589 1638	1368	1024	3044	1609	1279 675	981	935	367	390	211 <10
	viable Total Coliforms by IDEXX EnteroLert, MPN/100 mL	8297	5247	10462	10462	11199 9208	5012	14136	10462	12033	3538 14136	12033	14136	9804	12033	1701 <10
	Presence of **Human-source Enterococci** by PCR (esp gene marker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HF8 marker by PCR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Presence of **Human-source Bacteroides** HuBac marker by PCR	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-
Presence of Pathogenic Bacteria (by PCR)	**Salmonella sp**. (IpaB gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E. coli O157:H7 (rfb gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Campylobacter jejuni (HipO gene)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Staphylococcus aureus (clfA gene)	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Pathogenic Protozoans (by IMS/IMF)	**Cryptosporidium oocysts** (per 100 L)	nd	<1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Giardia cysts (per 100 L)	nd	<1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Presence of Human viruses (by PCR)	**Human Adenovirus**	+	+	+	-	+	+	-	-	-	+	+	-	-	-	-
	Noroviruses	nd	+	nd	nd	nd	nd	nd	nd	nd	-	nd	-	-	nd	-
	Enteroviruses	nd	+	nd	nd	nd	nd	nd	nd	nd	-	nd	-	-	nd	-