This document contains the 2004 Princess Cruise Lines Island Princess Sampling Episode Report for sampling episode 6505. The report and all the appendices can be downloaded from
http://www.epa.gov/owow/oceans/cruise_ships/island.html

Princess Cruise Lines Island Princess

Sampling Episode Report

March 2006

United States Environmental Protection Agency

Sampling Episode Report
Princess Cruise Lines - Island Princess
Sampling Episode 6505

U.S. Environmental Protection Agency

Oceans and Coastal Protection Division
Office of Wetlands, Oceans, and Watersheds

Engineering and Analysis Division
Office of Science and Technology

Office of Water
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

March 2006

ACKNOWLEDGMENT AND DISCLAIMER

This report was prepared by the Engineering and Analysis Division of the Office of Science and Technology and the Oceans and Coastal Protection Division of the Office of Wetlands, Oceans, and Watersheds of the U.S. Environmental Protection Agency. Neither the United States Government nor any of its employees, contractors, subcontractors, or their employees make any warrant, expressed or implied, or assume any legal liability or responsibility for any third party's use of, or the results of, such use of any information, apparatus, product, or process discussed in this report, or represents that its use by such party would not infringe on privately owned rights.

The primary contact regarding questions or comments on this document is:

Dr. Elizabeth Kim
U.S. Environmental Protection Agency
Oceans and Coastal Protection Division, OWOW (4504T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
(202) 566-1270 (telephone)
(202) 566-1546 (fax)
kim.elizabeth@epa.gov

For detailed technical inquiries on this document:

Donald Anderson
U.S. Environmental Protection Agency
Engineering and Analysis Division, OST (4303T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
(202) 566-1021 (telephone)
(202) 566-1053 (fax)
anderson.donaldf@epa.gov

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

Pages

EXECUTIVE SUMMARY

Sampling Episode Report for Island Princess

This Sampling Episode Report describes the sampling and analysis activities to characterize wastewater (graywater and sewage) generated and discharged by the cruise vessel Island Princess while in Alaska waters. This sampling took place from August 28 through September 2, 2004, under the direction of the U.S. Environmental Protection Agency (EPA). The sampling program is part of EPA's data collection effort to evaluate whether to develop wastewater discharge standards, under 33 USC 1901 Note, for cruise vessels authorized to carry 500 or more passengers for hire when operating in the waters of the Alexander Archipelago or the navigable waters of the United States within the State of Alaska or within the Kachemak Bay National Estuarine Research Reserve. EPA will use information from the sampling of this vessel and three other cruise ships in Alaska to characterize wastewater generated and discharged by large cruise vessels with advanced wastewater treatment systems.

EPA selected the Island Princess to characterize the performance of the Hamworthy KSE Ltd. membrane bioreactor treatment system, a wastewater treatment system that uses aerobic biological oxidation followed by ultrafiltration and ultraviolet disinfection. Samples were collected of various graywater sources (galley, laundry, accommodations, and food pulper wastewater); influent to the treatment system (mixed accommodations wastewater and sewage); influent to UV disinfection component of the treatment system; effluent from the treatment system; source water; wastewater treatment residuals (screening solids and wastewater biosludge); and incinerator ash. Most wastewater samples were collected for five consecutive 24-hour sampling periods; food pulper wastewater, treatment residuals, and incinerator ash were collected for a single 24-hour sampling period.

Strap-on ultrasonic flow meters were installed near the sampling locations for the galley wastewater, accommodations wastewater, influent to treatment, and effluent from treatment to collect flow data and to trigger automatic sampling machines.

Various sample collection methods (composite by flow, composite by time, grab, and grab composite) were used depending on the sampling point and analyte. Tested analytes included pathogen indicators (fecal coliform, *E.coli*, and enterococci), classical pollutants, total and dissolved metals, volatile and semivolatile organics, pesticides, polychlorinated biphenyls, and dioxins and furans. Not all samples were analyzed for all target analytes.

The galley wastewater samples showed the largest number of analytes detected among graywater sources and the highest concentrations of several analytes commonly used to measure wastewater strength: all three pathogen indicators, biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), hexane extractable material (HEM), silica-gel hexane extractable material (SGT-HEM), and total suspended solids (TSS). Laundry wastewater samples had the highest concentration among graywater sources for six analytes, while accommodations wastewater had the highest concentration for five analytes.

Because of water conservation measures onboard cruise ships (such as vacuum toilets), key analytes such as pathogen indicators, BOD_5, COD, and TSS are found at much higher concentrations in the influent to the Island Princess wastewater treatment system than in typical domestic wastewater. Of the 54 metal analytes tested for, 27 were detected in every influent to treatment system sample. Among the 203 target analytes for volatile and semivolatile organics and pesticides, only 6 were detected in any Island Princess influent to treatment samples, most at concentrations close to their detection limits. Among the 160 polychlorinated biphenyl (PCBs) analytes tested for, 36 were detected in Island Princess influent to treatment samples.

The Island Princess' Hamworthy wastewater treatment system treats only accommodations wastewater and sewage. The system successfully removed almost all pathogen indicators (>99%) and most classical pollutants, metals, and organics. Fecal coliform, a pathogen indicator, was detected in only 1 of the 15 effluent from treatment samples, while enterococci and *E. coli* were each detected in 3 of 15 effluent samples at concentrations close to their detection limits. The treatment system removed almost all BOD_5 (99%), COD (93%), TOC (89%), settleable residue (>99%) and TSS (99%). The treatment system reduced ammonia by 58%, total Kjeldahl nitrogen (TKN, which measures both ammonia and organic forms of

nitrogen) and total phosphorus by approximately 75%, while nitrate/nitrite levels remained relatively unchanged. The treatment system was highly efficient at removing particulate metals, and removed dissolved metals at an average of 37%. The treatment system removed most of the volatile and semivolatile organics to concentrations below detection levels.

The Hamworthy wastewater treatment system generates two types of residual waste: screening solids (from the two screen presses at the beginning of the treatment system) and waste biosludge (excess biological mass from the treatment system's bioreactor). Screening solids are collected and incinerated onboard. Waste biosludge is pumped to a double-bottom holding tank for overboard discharge outside of 12 nautical miles from shore. Most of the analytes detected in the waste biosludge were also detected in the influent to the treatment system. For many analytes, concentrations in the screening solids and waste biosludge exceeded those in the influent to treatment, suggesting that these analytes are removed from the system in these waste streams.

On average, each person generated approximately 41 gallons of treated accommodations and sewage wastewater per person per day.

1.0 INTRODUCTION

This Sampling Episode Report describes the Environmental Protection Agency's sampling and analysis activities to characterize graywater and sewage generation and treatment by Princess Cruises' cruise ship Island Princess (Island) while in Alaska waters. This sampling took place from August 28 through September 4, 2004, under the direction of the Engineering and Analysis Division of the Office of Science and Technology, and the Oceans and Coastal Protection Division of the Office of Wetlands, Oceans, and Watersheds of the U.S. Environmental Protection Agency (EPA).

The Island is a 88,000 gross ton cruise vessel launched in 2003. The vessel has 16 decks, a length of 964 feet, and a beam of 106 feet. The Island's maximum cruising speed is 24 knots. Its port of registry is Bermuda. During the sampling episode, the Island carried 2,019 passengers and 906 crew. The ship's itinerary was as follows:

Date	Port
August 28, 2004	Whittier, AK
August 29, 2004	Cruising College Fjord
August 30, 2004	Cruising Glacier Bay
August 31, 2004	Skagway, Alaska
September 1, 2004	Juneau, Alaska
September 2, 2004	Ketchikan, Alaska
September 3, 2004	Cruising Inside Passage
September 4, 2004	Vancouver, B.C.

This sampling program is a part of EPA's data collection effort to evaluate whether to develop wastewater discharge regulations for cruise vessels authorized to carry 500 or more passengers for hire when operating in the waters of the Alexander Archipelago or the navigable waters of the United States within the State of Alaska or within the Kachemak Bay Estuarine Research Reserve (hereafter referred to as Alaska waters). Such regulations are authorized by "Title XIV - Certain Alaskan Cruise Ship Operations" of the Miscellaneous Appropriations Bill (H.R. 5666) passed by Congress on December 21, 2000, in the Consolidated

Appropriations Act of 2001 (Pub L. 106-554, Sections 1401-1414, 33 USC 1901 Note). The data and information gathered through this sampling episode were collected using EPA's authority under section 308 of the Clean Water Act, as also provided by Title XIV. Princess Cruise Lines voluntarily provided information and data gathered for and represented in this report, notwithstanding the above cited authority, in the interest of research for the improvement of wastewater treatment standards.

EPA selected the Island to characterize the performance of the Hamworthy KSE Ltd. (Dorset, England) membrane wastewater bioreactor treatment system (Hamworthy treatment system), an advanced wastewater treatment system that uses aerobic biological oxidation followed by ultrafiltration and ultraviolet (UV) disinfection. EPA will use the analytical and flow data included in this sampling episode report to evaluate the performance of the Hamworthy treatment system, and to analyze patterns and variability in wastewater sources.

Samples were collected in accordance with with procedures specified in the *Generic Sampling Plan for Large Cruise Ships in Alaska Waters* (Generic SAP) and the ship-specific *Sampling and Analysis Plan for the Island Princess* (Island SAP). The Island SAP is presented in Appendix E and the Generic SAP is available on EPA's website at http://www.epa.gov/owow/oceans/cruise_ships/GenericSAP040602.pdf. Pathogen indicator analyses were performed onboard. Samples for all other analyses were shipped to shoreside EPA-contract laboratories for analysis. Appendix D identifies all EPA-contract laboratories used in this sampling episode.

Section 2.0 of this report describes the generation, collection, and treatment of graywater and sewage on the Island, as well as the sampling point and flow meter locations used in this sampling episode. Section 3.0 describes the sample collection methods and deviations from the Island SAP. Section 4.0 presents and analyzes the analytical, flow, and shipboard data collected during the sampling episode. Section 5.0 describes the quality assurance and quality control (QA/QC) procedures and results. Section 6.0 presents references used in this document. Tables and figures referred to in the text are located at the end of each section.

2.0 WASTEWATER SYSTEM AND SAMPLING POINTS

This section describes graywater and sewage generation, collection, and treatment on the Island, as well as the sample collection points and flow meter locations and installation points used in this sampling episode.

2.1 Wastewater Generation and Collection

The ship's collection, holding, and transfer system (CHT) collects and transfers graywater and sewage generated onboard to the ship's Hamworthy treatment system or to overboard discharge. For the purpose of this report, graywater refers to non-sewage wastewaters that are collected by the CHT system. The CHT system is composed of five subsystems, referred to by the ship's crew as the galley, food pulper, accommodations, laundry, and sewage systems. Figure 2-1 is a simplified diagram of the Island's graywater and sewage CHT system. Wastewater sources collected by each of the five subsystems are described in Table 2-1. The Hamworthy treatment system treats only accommodations wastewater and sewage. The other wastewaters are stored in double-bottom holding tanks untreated and discharged overboard outside of 12 nautical miles (nm).

Potable water is used as source water for all ship operations that generate graywater and sewage (e.g., laundry, galley, food pulper, sinks, showers, and toilets). Potable water is produced onboard and bunkered while in port, with produced water providing approximately two-thirds of freshwater requirements and bunkered water providing approximately one-third of fresh water requirements.

2.2 Wastewater Treatment

The Island is outfitted with a Hamworthy treatment system, an advanced treatment system that uses aerobic biological treatment followed by ultrafiltration and ultraviolet (UV) disinfection. Figure 2-2 provides a simplified diagram of the Hamworthy treatment system. This system treats only accommodations wastewater and sewage onboard the Island.

Wastewater from the accommodations CHT system culminates in two holding tanks, which are pumped to two wastewater buffer tanks, the first component of the Hamworthy treatment system. Air is added via blowers to aerate the buffer tanks. The sewage CHT system culminates in four sewage collection tanks. Accommodations wastewater from the buffer tanks and sewage from the storage collection tanks mixes in a common line and then splits for treatment through two parallel treatment trains. The first unit of the treatment trains are self-cleaning screen presses (mesh size 400 µm) to remove paper and other coarse solids. Next, the wastewater is pumped to the first stage aerated bioreactors, then to interstage bag filters (mesh size 200 µm) and filtrate tanks, and finally to the second stage aerated bioreactors. Mixed liquor (wastewater containing organic matter and biological floc) overflows from the second stage bioreactors back to the first stage bioreactors. Bioreactor aeration is provided by fine bubble diffusers at the bottoms of the bioreactors.

From the second stage bioreactors, the wastewater is pumped through the membrane filters (ultrafiltration, pore size 40 nm) and collects into permeate tanks. The membrane filters use cross flow design (wastewater flows parallel to membrane surface) to minimize fouling. Membrane concentrate, consisting of particulate matter and mixed liquor, is returned to the second stage bioreactors. Approximately once every two weeks, the treatment trains are taken offline for approximately 1.5 hours to disinfect the membrane filters using sodium hypochlorite; the sodium hypochlorite solution remains in the system. (When one treatment train is being disinfected, all wastewater is diverted to the second, parallel treatment train.) In the final stage of treatment, the combined wastewater from the two permeate tanks undergoes UV disinfection. The hydraulic residence time of the treatment system (i.e., the amount of time the wastewater stays in the treatment system) is less than one day.

According to the ship's crew, the Hamworthy system can treat 600 m^3 (159,000 gallons) per day of sewage and accommodations wastewater generated onboard, well in excess of its typical daily load, approximately 450 m^3 (119,000 gallons) as determined by interviews with the ship's crew and measured flows collected during the sampling episode.

The Hamworthy treatment system operates continuously, regardless of the ship's location (e.g., in port, at sea within Alaska waters, at sea outside Alaska waters). The vessel typically continuously discharges treated wastewater from this system overboard. Where overboard discharge is prohibited, such as in Glacier Bay National Park, treated wastewater is diverted to storage in double-bottom holding tanks and held for eventual discharge overboard outside 12 nautical miles (nm) from shore.

Treated wastewater is recycled back to the treatment system when effluent total suspended solids concentrations exceed 27 mg/L (determined based on a correlation to measured effluent turbidity) to ensure that inadequately treated wastewater is not discharged.

The Hamworthy system generates three types of residual waste: screening solids (from the screen presses), spent bag filters (from the interstage bag filters), and waste biosludge (excess biological mass from the second stage bioreactors). The screening solids (50 kilograms/day) drop from the dry waste outlets of the screen presses and collect into plastic bags. The bag filters are replaced every 200 hours of operation. The plastic bags containing both screening solids and spent bag filters are manually fed to the onboard incinerator via a small chute. Incinerator ash is disposed of on shore as a non-hazardous waste.

Approximately 10 metric tons of waste biosludge are removed from the second stage bioreactors each week to maintain bioreactor total suspended solids (mixed liquor suspended solids (MLSS)) concentrations at approximately 20,000 mg/L. The biosludge is not dewatered and is immediately discharged overboard (i.e., it is not discharged to holding tanks); therefore, biosludge is wasted only when the vessel is greater than 12 nm from shore.

The Hamworthy treatment system includes a total of 48 membrane modules, arranged in four groups of four sets of three. At any given time, only two of the three membrane modules in each set are operated; the third membrane module in each set is a backup module. One membrane module is cleaned each day, so the membrane cleaning cycle repeats every 48 days. The cleaning process uses "Membrane Cleaner Part 1" and "Membrane Cleaner Part 2"

and clean water, and requires a total of eight hours. The nonhazardous wash wastewater is collected in a double-bottom holding tank and discharged at sea outside of 12 nm.

Wastewater flow through the treatment system is controlled by the accommodations wastewater and sewage pumps. However, during periods of reduced treatment capacity (e.g., maintenance), seven double-bottom holding tanks provide a holding capacity of 822 m^3. The contents of these holding tanks can either be pumped to the wastewater treatment system or held for discharge without treatment outside 12 nm from shore.

2.3 Wastewater and Residual Sample Collection Points

Samples were taken from the graywater sources (galley, laundry, and accommodations); influent to the treatment system (combined accommodations wastewater and sewage); influent to the UV disinfection portion of the treatment system; effluent from the treatment system; source water (water from the ship's potable water system); wastewater treatment residuals; and incinerator ash. Table 2-1 describes the wastewaters sampled, their sampling point locations, their flow meter locations (if applicable), and the number of days they were sampled. Table 2-2 provides the same information for the treatment residuals and incinerator ash sampled. In general, food pulper and wastewater treatment residual samples were taken for one 24-hour period, while samples of accommodations, galley, and laundry wastewater and the influent to and effluent from the treatment system were taken for five 24-hour periods. See Section 3.2 and Table 3-2 for information on the analytes tested. Note that samples were also collected of galley, laundry, and food pulper wastewaters as they were discharged untreated from a double-bottom holding tank.

Samples were collected from the ship's potable water system (source water) to determine if any of the target analytes were present as background contamination. One trip blank was prepared and analyzed for volatile organics to evaluate possible contamination during shipment and handling of samples. Finally, an equipment blank was prepared and analyzed to evaluate possible contamination caused by the sampling equipment.

Samples were not taken directly from the sewage CHT system. In addition, samples could not be collected of wastewater held in double-bottom holding tanks for discharge outside 12 nm from shore (i.e., treated effluent diverted to storage while the ship cruised Glacier Bay) because (1) double-bottom holding tanks cannot be accessed directly due to safety considerations, and (2) sampling from the holding tank discharge manifold would characterize combined holding tank discharges and not discharges specific to the holding tanks of interest.

2.4 Flow Meter Locations

Strap-on flow meters (Controlotron Model 1010) were installed at four sampling locations to collect flow data and to control automatic composite sample machines (by triggering sample collection after a defined amount of flow passed through the pipe). The first flow meter location was on the outlet pipe from the crew galley wastewater collection tank (galley wastewater, SP-1; see Table 2-1 for a description of wastewaters and Figure 2-1 for a simplified graywater and sewage CHT system diagram showing sampling points and flow meter locations). The second location was on the outlet pipe from one of the eleven accommodations collection tanks (accommodations wastewater, SP-3; see Table 2-1 and Figure 2-1). The third location was at the influent to the wastewater treatment system on the combined wastewater inlet pipe to the screen presses (SP-4; see Table 2-1 and Figure 2-2). The final location was at the effluent from the treatment system (on the overboard discharge line for the treated effluent, SP-6/7; see Table 2-1 and Figure 2-2).

The sampling point for laundry wastewater was located on piping that would not support installation of a strap-on flow meter (see Table 2-1), precluding collection of flow data and flow-weighted composite samples at this sampling point. Time-weighted composite samples were collected at the laundry wastewater sampling point (see Table 3-1 for a description of the sample collection method). Flow estimates for the food pulper wastewater were provided by the ship's crew.

Table 2-1

Wastewater, Sampling Point, and Flow Meter Descriptions, Island Princess

Descriptions of wastewaters sampled, sampling point locations, flow meter locations, and number of days sampled for the Island sampling episode (August 28 through September 4, 2004).

Wastewater Name	Wastewater Description(a)	Sampling Point # (a) (b)	Sampling Point Description(b)	Flow Meter Description(b)	# of Days Sampled
Galley	Wastewater from dishwashers, food preparation, galley sinks and floor drains, and sinks in restaurants, bars, and cafes. Galley wastewater drains to three collection tanks and eight holding tanks located throughout the ship (see Figure 2-1). Galley wastewater from these holding tanks is discharged at sea without treatment. One-time grab samples were also taken of galley wastewater as it was discharged from the holding tanks (see SP-8).	SP-1	Sample tap was installed on the outlet pipe from the crew galley collection tank. According to the ship's crew, all collection and holding tanks receive similar wastewater; therefore, the specific collection tank sampled was selected based on accessibility.	Strap-on flow meter was installed on the outlet pipe from the crew galley wastewater collection tank (the same outlet pipe as the installed sample tap).	5
Laundry	Wastewater from the main laundry, crew laundry, passenger laundrettes, and small items laundries. All laundry wastewater drains to three holding tanks and is discharged at sea without treatment. One-time grab samples were also taken of laundry wastewater as it was discharged from the holding tanks (see SP-9).	SP-2	Sample tap was installed on the inlet pipe to one of the laundry wastewater holding tanks. According to the ship's crew, all three holding tanks receive similar wastewater; therefore, the specific collection tank samples was selected based on accessibility.	Flow data for laundry wastewater were not obtained. Strap-on flow meter set up and calibration procedures were unsuccessful at the inlet pipe to the laundry wastewater holding tank, most likely due to poor pipe flow conditions such as pipe scaling or extreme aeration. Pipe configurations precluded all other potential flow meter locations.	5

(a) List of wastewaters may not be comprehensive.
(b) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(c) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(d) Graywater overboard discharge sources are typically discharged simultaneously through a common overboard discharge line. A single sample tap was installed on the overboard discharge line, but for the purposes of sampling the individual graywater overboard sources, ship personnel discharged each graywater source in series, so each source could be sampled separately.

Table 2-1 (Continued)

Wastewater Name	Wastewater Description(a)	Sampling Point # (a) (b)	Sampling Point Description(b)	Flow Meter Description(b)	# of Days Sampled
Accommodations	Wastewater from sinks, tubs, and showers in guest and crew rooms, pantry areas, medical floor drains and sinks, most interior deck drains, and non-engine room shop sinks. Accommodations wastewater drains to 11 collection tanks located throughout the ship and then is pumped into two holding tanks equal in size.	SP-3	Sample tap was installed on the inlet pipe to one of the accommodations wastewater collection tanks. According to the ship's crew, all collection tanks receive similar wastewater; therefore, the specific collection tank sampled was selected based on accessibility.	Strap-on flow meter was installed on the inlet pipe to one of the accommodations wastewater collection tanks (the same inlet pipe as the installed sample tap).	5
Influent to Hamworthy Treatment System	Combined wastewaters from the accommodations and sewage collection, holding, and transfer (CHT) systems. Does not include galley, laundry, and food pulper wastewaters, which are discharged at sea without treatment. A vacuum CHT system conveys sewage from passenger and crew toilets and urinals. Accommodations CHT system culminates in two holding tanks which are pumped to two wastewater buffer tanks, the first component of the Hamworthy treatment system. The sewage CHT system culminates in four sewage collection tanks. Wastewater from the buffer tanks and sewage collection tanks mixes in a common line as it flows to the screen press component of the Hamworthy treatment system.	SP-4	Sample tap was installed on the combined wastewater inlet pipe to the screen presses.	Strap-on flow meter was installed on the inlet pipe to the screen presses (the same pipe as the installed sample tap).	5

(a) List of wastewaters may not be comprehensive.
(b) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(c) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(d) Graywater overboard discharge sources are typically discharged simultaneously through a common overboard discharge line. A single sample tap was installed on the overboard discharge line, but for the purposes of sampling the individual graywater overboard sources, ship personnel discharged each graywater source in series, so each source could be sampled separately.

Table 2-1 (Continued)

Wastewater Name	Wastewater Description(a)	Sampling Point # (a) (b)	Sampling Point Description(b)	Flow Meter Description(b)	# of Days Sampled
Influent to UV Disinfection Part of Hamworthy Treatment System	Wastewater following treatment by biological oxidation but ultrafiltration but prior to ultraviolet (UV) disinfection.	SP-5	Sample tap was installed on the inlet pipe to the UV disinfection unit.	Flow measurements not required.	5
Effluent from Hamworthy Treatment System	Final treated wastewater effluent from the Hamworthy wastewater treatment system. Effluent is typically continuously discharged overboard. Where discharge is prohibited (e.g., Glacier Bay), wastewater is diverted to storage in double-bottom holding tanks for discharge overboard outside 12 nm from shore.	SP-6/7	Sample tap was installed on the overboard discharge pipe for the treated effluent about 1 meter upstream of the discharge port (i.e., on the effluent pipe from the UV disinfection unit, downstream of the diversion valve that directs wastewater to either overboard discharge or to storage in double-bottom holding tanks).	Strap-on flow meter was installed on the overboard discharge pipe for the treated effluent about 1 meter upstream of the discharge port (i.e., on the effluent pipe from the UV disinfection unit, downstream of the diversion valve that directs wastewater to either overboard discharge or to storage in double-bottom holding tanks) (the same pipe as the installed sample tap).	5
Galley Overboard Discharge	Galley wastewater from the 8 holding tanks is discharged untreated outside of 12 nm from shore. Galley wastewater from each of these tanks is combined in a common line for overboard discharge.	SP-8	Sample tap was installed on the overboard discharge line. (d)	Flow measurements not required. Approximately 250 m^3 of galley wastewater is generated per day, according to the ship's crew.	1 (August 26, 2005, prior to sampling episode; see Table 3-5)
Laundry Overboard Discharge	Laundry wastewater from the three holding tanks is discharged untreated outside of 12 nm from shore. Laundry wastewater from the holding tanks is combined in a common line for overboard discharge.	SP-9	Sample tap was installed on the overboard discharge line. (d)	Flow measurements not required. Approximately 160 m^3 of laundry wastewater is generated per day, according to the ship's crew.	1 (August 26, 2005, prior to sampling episode; see Table 3-5)

(a) List of wastewaters may not be comprehensive.
(b) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(c) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(d) Graywater overboard discharge sources are typically discharged simultaneously through a common overboard discharge line. A single sample tap was installed on the overboard discharge line, but for the purposes of sampling the individual graywater overboard sources, ship personnel discharged each graywater source in series, so each source could be sampled separately.

Table 2-1 (Continued)

Wastewater Name	Wastewater Description(a)	Sampling Point # (a) (b)	Sampling Point Description(b)	Flow Meter Description(b)	# of Days Sampled
Food Pulper Overboard Discharge	Wastewater from the Somat food pulper system. Food waste is mixed with water and processed into a slurry. The food slurry is then separated into semi-dry food solids and wastewater (food pulper wastewater). Food pulper wastewater is routed to a food pulper wastewater holding tank for recirculation back to the Somat system; Gamazyme Boe is added to the recirculated wastewater as a bio odor eliminator. Every few days, the food pulper wastewater is drained from the holding tank to a storage tank and replaced with fresh water. Both food pulper wastewater and dewatered food waste are stored for discharge untreated outside of 12 nm from shore.	SP-10	Sample tap was installed on the overboard discharge line. (d)	Flow measurements not required. Approximately 31 m^3 of food pulper wastewater is generated per day, according to the ship's crew.	1 (August 26, 2005, prior to sampling episode; see Table 3-5)
Source Water	Potable water used as source water for all systems that generate wastewater that is treated by the Hamworthy treatment system.	SP-14	Samples collected from a water fountain located near the sample staging area.	Flow measurements not required.	1 (Day 2)

(a) List of wastewaters may not be comprehensive.
(b) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(c) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(d) Graywater overboard discharge sources are typically discharged simultaneously through a common overboard discharge line. A single sample tap was installed on the overboard discharge line, but for the purposes of sampling the individual graywater overboard sources, ship personnel discharged each graywater source in series, so each source could be sampled separately.

Table 2-2

Treatment Residuals and Incinerator Ash Descriptions, Island Princess

Descriptions of treatment residuals and incinerator ash sampled, sampling point locations, flow meter locations, and number of days sampled for the Island sampling episode (August 28 through September 4, 2004).

Treatment Residual Name	Treatment Residual Description	Sampling Point # (a)	Sampling Point Description	Flow Meter Description	# of Days Sampled
Screening Solids	Solids generated by the screen presses of the Hamworthy treatment system. Screening solids are collected from the screen presses' dry waste discharge lines and put into bags. Screening solids bags are incinerated onboard.	SP-11	Samples were collected directly from the solids collection bags.	Flow measurements not required. Approximately 50 kg of screening solids are generated per day, according to the ship's crew.	1 (Day 3)
Waste Biosludge	Each week when the ship is outside 12nm from shore, waste biosludge is removed from the bioreactors of the Hamworthy wastewater treatment system and immediately discharged overboard (i.e., it is not stored in double-bottom holding tanks).	SP-12	Sample tap was installed on the waste biosludge overboard discharge pipe.	Flow measurements not required. Approximately 10 metric tons of waste sludge are removed from the second stage bioreactors each week, according to the ship's crew.	1 (Day 1)
Incinerator Ash	Ash generated from the incineration of trash (e.g., cardboard, paper, plastic), screening solids, and spent bag filters. Incinerator ash is collected in incinerator ash storage hoppers for disposal onshore.	SP-13	Samples were collected directly from an incinerator ash storage hopper.	Flow measurements not required.	1 (Day 3)

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island's graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.

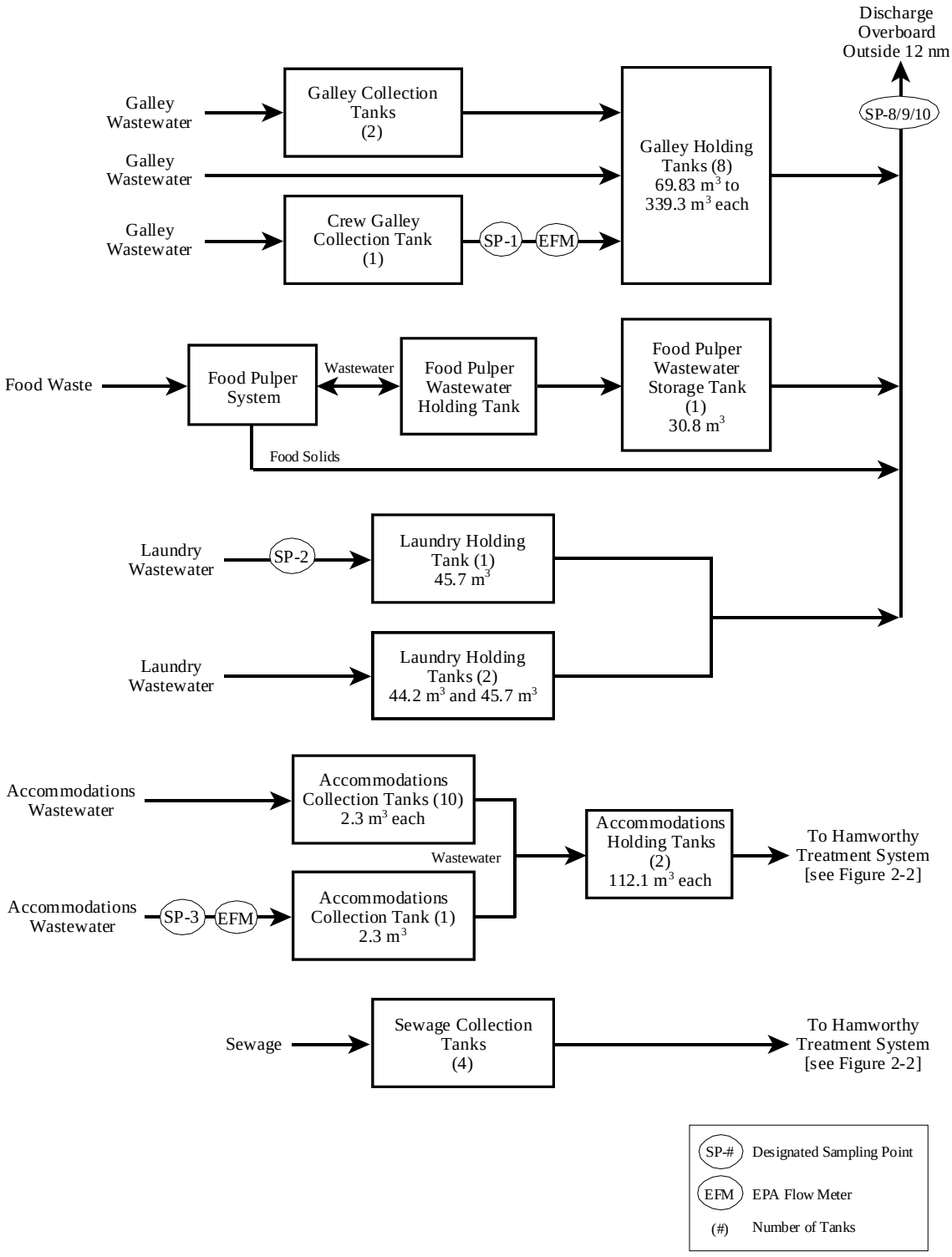

Figure 2-1. Graywater and Sewage Collection, Holding, and Transfer System, Island Princess

Simplified diagram of the Island Princess graywater and sewage CHT system. See Table 2-1 for a list of streams in each wastewater source.

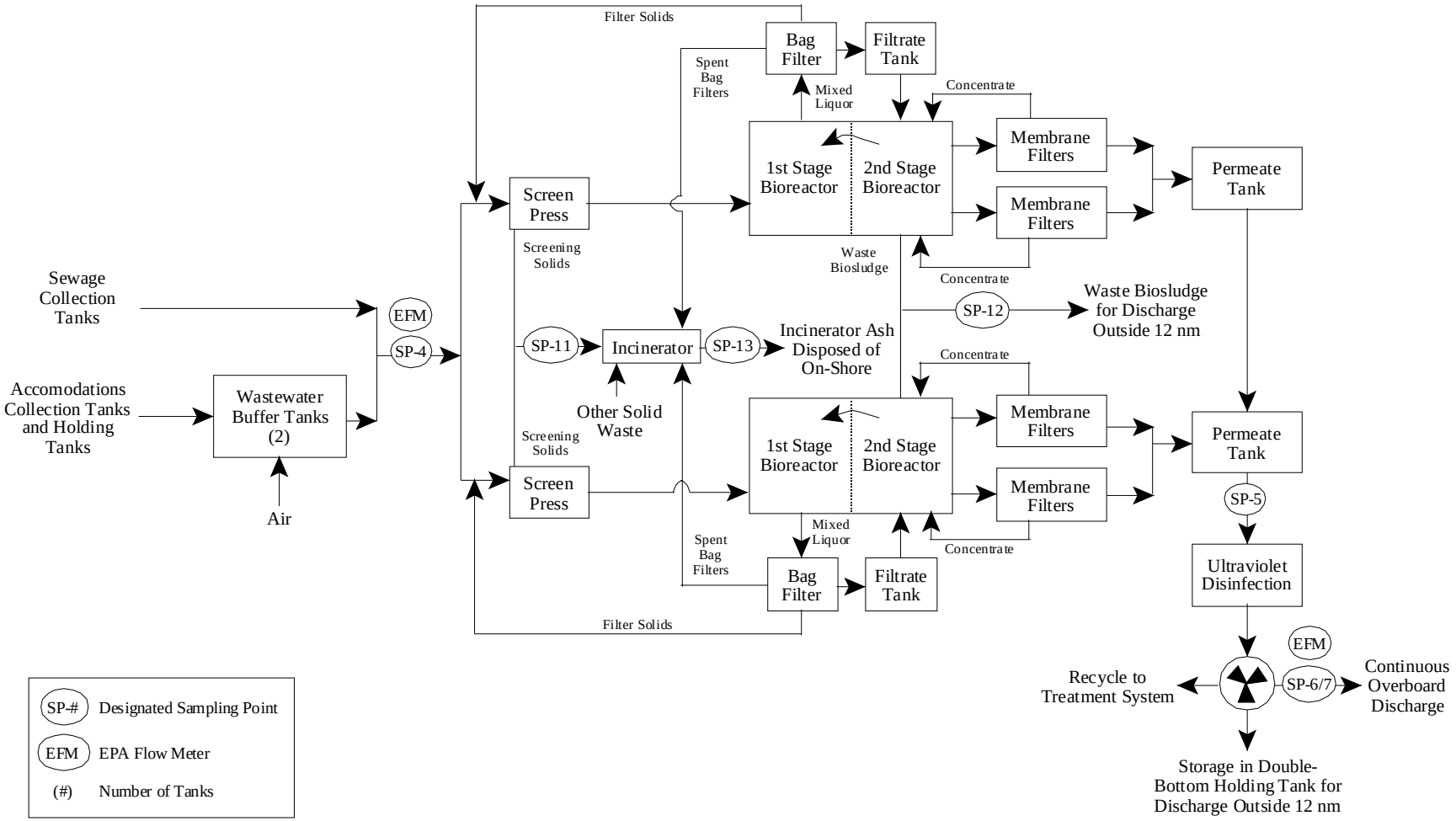

Figure 2-2. Hamworthy Treatment System, Island Princess

Simplified diagram of the Island Princess Hamworthy treatment system. See Table 2-1 for a list of wastewater streams in each wastewater source, and Figure 2-1 for their collection and conveyance to the treatment system.

3.0 SAMPLE COLLECTION METHODOLOGY

This section describes the sample collection and analysis methods and deviations from the ship-specific Sampling and Analysis Plan for Island Princess (Island SAP; Appendix E). A more detailed explanation of the sampling methodologies, analytes and analytical methods, sampling frequency and duration, schedule, and logistics that were followed during the sampling onboard the Island can be found in Section 3.0 of the Island SAP.

3.1 Pre-Sampling Activities

EPA performed an engineering ship visit to the Island on March 25, 2004. The Island SAP was prepared based on information colleted during that ship visit and from subsequent follow-up communication with Princess personnel. One week prior to the sampling episode, personnel conducted sampling setup activities onboard the Island, including loading sampling equipment and the onboard laboratory, inspecting the installed sampling ports, installing the strap-on ultrasonic flow meters, and installing and programming the automatic sampling machines.

3.2 Sample Collection and Analysis Methodology

In general, samples of laundry, galley, and accommodations wastewater and influent to and effluent from the treatment system were taken for five consecutive 24-hour periods, while wastewater treatment residual samples were taken for one 24-hour period (see Tables 2-1 and 2-2). System piping precluded collection of samples of food pulper wastewater as generated.

Laundry, galley, and food pulper wastewaters are stored in holding tanks for 2 to 5 days before being discharged untreated outside of 12nm from shore. One-time grab samples of these wastewaters were collected, primarily to determine their pathogen indicators counts. Because the onboard pathogen indicators laboratory was not yet operating at the time of sample

collection, pathogen indicator analyses for these samples were performed approximately 18 hours outside the required 6-hour holding time; the resulting data are not considered valid. However, other analytes were also analyzed for; results are presented in Appendix A-2.

Various sample collection methods (described in Table 3-1) were used depending on the waste stream and analyte (see Table 3-2). Most samples were composited over each 24-hour sampling period or were single grab samples in a 24-hour period. However, multiple (1 to 3) grab samples per 24-hour period were collected for pathogen indicator analyses because these samples must be analyzed within 6 hours of collection (see Table 3-2). Table 3-3 describes the analyte groups and lists the analytical methods used.

Each time a grab or grab composite sample was taken, another separate sample was placed in a separate container to perform field measurements of pH, temperature, conductivity, salinity, turbidity, sulfide, and free and total chlorine onboard. Temperature and pH were measured immediately at the sampling point, and the remaining parameters were measured at the sample staging area onboard. See Table 3-4 for equipment used for these measurements. Field measurements are used primarily to determine sample preservation requirements. Samples (other than those used for field measurements) were preserved in accordance with procedures described in the Island SAP (Appendix E), with exceptions as noted in Section 3.6 and Table 3-5. Note that while Alaska and Federal regulations for cruise ship discharges include standards for total residual chlorine, the equipment used to measure residual chlorine onboard was not suitable for measuring low levels of chlorine (detection limit of 20 µg/L compared to a standard of 10 µg/L) and was subject to various interferences, such as from oxidized forms of manganese. Accordingly, the field measurements collected during this sampling episode should not be used to assess compliance with cruise ship discharge standards.

Flow data were collected from the strap-on flow meters installed by the sampling team. See Section 2.4 for descriptions of the flow meter locations and Figures 2-1 and 2-2 for their locations. The flow meters were programmed to record the instantaneous flow rate (m^3/min) and total flow (m^3) every five minutes.

3.3 Converting Solids Mass Units to Volume Units

The screening solids samples had high solids contents; therefore, the results for classical pollutants, metals, and volatile and semivolatile organics were reported by the laboratories in mass units. To allow for direct comparison of these results to those of other wastewater samples, mass units for this sample were converted to volume units using the following equation and assuming a sample density of 1:

Amount (mass units) * (% solids/100) = Amount (volume units)

All data in this report pertaining to the screening solids sample are reported in volume units. The laboratory data packages, which are included in the Cruise Ship Rulemaking Record and available upon request, contain the original mass units results reported by the laboratories. Note that the analytical results for the incinerator ash sample were also reported in mass units. However, the incinerator ash results were not converted because the sample was >90% solids.

3.4 Quality Assurance/Quality Control

Duplicate samples were collected for quality assurance and quality control. Results for duplicate samples were averaged. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling. Other field quality control samples prepared for this sampling episode include a trip blank and an equipment blanks, which are discussed in Sections 5.2.1 and 5.2.2, respectively.

3.5 Interview with the Ship's Crew

The ship's crew was interviewed to obtain information regarding activities that impact wastewater generation. See Appendix C for details on these interviews and Section 4.2 for a summary.

3.6 Deviations from the Sampling and Analysis Plan

The sampling episode proceeded as specified in the Island SAP with the deviations described in Table 3-5.

Table 3-1

Sample Collection Method Descriptions, Island Princess

Sample Collection Method	Description
Composite by Flow	Flow-weighted composite samples were collected using an automatic sampling machine interfaced with an installed strap-on ultrasonic flow meter (see Section 2.4). The flow meter signaled the automatic sampling machine to collect a 250-mL sample aliquot each time a fixed quantity of wastewater passed through the wastewater pipe. The number of composite sample aliquots collected per 24-hour sampling period ranged from approximately 30 to 60, depending on the total volume of sample required for the planned analyses each sampling day. Sample aliquots were collected into a 10-L sample composite jar stored within the sampling machine. At the end of each 24-hour period, the sample composite jar(s) were mixed and poured into individual sample bottles for analysis. Samples collected using the composite-by-flow method best represent a waste stream flowing through a pipe.
Composite by Time	Time-weighted composite samples were collected using an automatic sampling machine programmed to collect 250-mL sample aliquots at fixed time intervals. The programmed time interval differed by sampling point (see Table 3-2). The number of composite sample aliquots collected per 24-hour sampling period ranged from approximately 30 to 40, depending on the total volume of sample required for planned analyses. Sample aliquots were collected into a 10-L composite jar stored within the sampling machine. At the end of the 24-hour sampling period, the sample composite jar(s) were mixed and poured into individual sample bottles for analysis. The composite-by-time method was used when composite-by-flow method was not feasible.
Grab	Grab samples were discrete samples collected directly into the sample bottles from the sample tap or through Teflon® tubing connected to the sample tap. Note that samples for pathogen indicator analyses were collected as grab samples (as opposed to composite sample) because they must be analyzed within a 6-hour holding time.
Grab composite	Samples (1 to 4 per 24-hour sampling period) were manually collected as grab samples but composited either in the field or at the laboratory for a single analysis. The grab composite method was used when composite-by-flow or composite-by-time methods were not appropriate. **Volatile organics** – grab samples were collected directly into sample vials, which were filled completely to avoid loss of target analytes by volatilization. Grab samples for each 24-hour period for analysis of volatile organics were composited by the laboratory for a single analysis. **Total and available cyanide** – grab samples were chemically preserved as soon as possible to minimize sample interferences. The preserved total and available cyanide grab samples for each 24-hour period were composited onboard by the sampling team for a single analysis. **Hexane-extractable material/silica-gel treated hexane-extractable material (HEM/SGT-HEM)**– grab samples were collected directly into sample containers to avoid loss of HEM/SGT-HEM that might adhere to the interior of any interim sampling container (e.g., sample composite jar). The sampling team prepared composite HEM/SGT-HEM samples onboard for a single analysis per sampling point per day by filling approximately one-fourth (250-mL) of the sample containers when they collected each grab sample, resulting in 1-liter of sample in each container at the end of each sampling period.

Table 3-2

Sample Collection Method and Analyte Groups Tested by Sampling Point, Island Princess

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Galley	SP-1	**Composite by flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II Total and dissolved metals Semivolatile organics Pesticides	5
		Grab composite The collection times of the four subsamples in the composites each day can be found in Appendix A-3	Classical pollutants: -HEM/SGT-HEM -Total and available cyanide Volatile organics	
		Grab Two grab samples were taken per sampling day. Results are presented in Table 4-1 are an average for each sampling day. Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Laundry	SP-2	**Composite by time** Automatic sampling machine was programmed to collect 250-mL sample aliquots at three-minute time intervals. The sampling machine successfully collected sample aliquots only during the relatively few intervals during the 24-hour sampling periods (sampling periods began at 0600 each day) when the laundry wastewater holding tank discharge pump turned on, thereby more closely approximating a flow-weighted composite sample.	Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II Total and dissolved metals Semivolatile organics Dioxins and furans	5
		Grab Composite The number of subsamples in the composites taken per sampling day were as follows: 1, 3, 4, 4, 4. The collection times of the subsamples of the composites can be found in Appendix A-3.	Classical pollutants: -HEM/SGT-HEM -Total and available cyanide Volatile organics	
		Grab The number of grab samples taken per day were as follows: 1, 2, 2, 2, 2. Results presented in Table 4-2 are an average for each sampling day (calculation used detection limits for nondetected results). Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	
Accommodations	SP-3	**Composite by flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II Total and dissolved metals Semivolatile organics	5
		Grab composite The collection times of the four subsamples in the composites can be found in Appendix A-3.	Classical pollutants: -HEM/SGT-HEM -Total and available cyanide Volatile organics	5
		Grab Two grab samples were taken per sampling day. Results presented in Table 4-3 are an average for each sampling day (calculation used detection limits for nondetected results). Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Influent to Hamworthy Treatment System	SP-4	**Composite by flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II Total and dissolved metals Semivolatile organics Pesticides Polychlorinated biphenyls	5
		Grab composite The collection times of the four subsamples in the composites each day can be found in Appendix A-3.	Classical pollutants: -HEM/SGT-HEM -Total and available cyanide Volatile organics	
		Grab Three grab samples were taken per sampling day. Results presented in Table 4-6 are an average for each sampling day. Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	
Influent to UV Disinfection Part of Hamworthy Treatment System	SP-5	**Grab** Three grab samples were taken per sampling day. Results are presented in Table 4-7 are an average for each sampling day (calculation used detection limits for nondetected results). Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	5
Effluent from Hamworthy Treatment System	SP-6/7	**Composite by flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II Total and dissolved metals Semivolatile organics	5
		Grab composite The collection times of the four subsamples in the composites each day can be found in Appendix A-3.	Classical pollutants: -HEM/SGT-HEM -Total and available cyanide Volatile organics	
		Grab	Pathogen indicators	

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Galley Overboard Discharge	SP-8	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Pathogen indicators Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II -HEM/SGT-HEM -Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	1 (August 26, 2005, prior to sampling episode; see Table 3-5)
Laundry Overboard Discharge	SP-9	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Pathogen indicators Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II -HEM/SGT-HEM -Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	1 (August 26, 2005, prior to sampling episode see Table 3-5)
Food Pulper Overboard Discharge	SP-10	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Pathogen indicators Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II -HEM/SGT-HEM -Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	1 (August 26, 2005, prior to sampling episode see Table 3-5)

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Screening Solids	SP-11	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Classical pollutants: -Group I -Group II -Total and available cyanide Total metals Volatile and semivolatile organics	1 (Day 3)
Waste Biosludge	SP-12	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Classical pollutants: -Group I -Group II -Total and available cyanide Total metals Volatile and semivolatile organics	1 (Day 1)
Incinerator Ash	SP-13	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Total metals Semivolatile organics Dioxins and furans	1 (Day 3)
Source Water	SP-14	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Pathogen indicators Classical pollutants: -BOD_5 -Settleable residue -Group I -Group II -Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	1 (Day 2)
Trip Blank	SP-15	**Grab** One grab sample was taken. Appendix A-3 shows the collection time. High performance liquid chromatography (HPLC) water was poured directly into sample vials in the contractor's Chantilly, VA sampling room and shipped to the Island. The trip blank was shipped back (unopened) to the laboratory along with the collected samples.	Volatile organics	1 (Day 5)

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a) (b)	Sample Collection Method (c)	Analyte Groups Tested (d)	# of Days Sampled
Equipment Blank	SP-16	**Grab** One grab sample was taken. The equipment blank consisted of HPLC water pumped through the automatic sampling machine and tubing and directly into sample bottles.	Total and dissolved metals Semivolatile organics	1 (Day 1)

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Island graywater and sewage CHT and treatment systems indicating the sampling points and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.

Table 3-3

Analytes and Analytical Methods, Island Princess

Analyte Group	Analytes	Analytical Method Number
Pathogen Indicators	*E. coli*	EPA 9223B
	Enterococci	ASTM D6503-99
	Fecal coliform	EPA 9222D
Classical Pollutants	Biochemical oxygen demand (BOD_5)	EPA 405.1
	Settleable residue (SS)	EPA 160.5
	Group I: -Total suspended solids (TSS) -Total dissolved solids (TDS) -Sulfate -Chloride -Alkalinity	 EPA 160.2 EPA 160.1 EPA 375.4 EPA 325.3 EPA 310.1
	Group II: -Total organic carbon (TOC) -Chemical oxygen demand (COD) -Ammonia as nitrogen -Nitrate/nitrite as nitrogen -Total Kjeldahl nitrogen (TKN) -Total phosphorus	 EPA 451.1, Lloyd Kahn (“solids” samples) HACH 8000 EPA 350.1 EPA 353.2, EPA 1685 (“solids” samples) EPA 351.3, EPA 1687 (“solids” samples) EPA 365.1
	Oil and grease measured as hexane extractable material and petroleum hydrocarbons measured as silica-gel treated hexane extractable material (HEM/SGT-HEM)	EPA 1664
	Cyanide -Total cyanide -Available cyanide	 EPA 335.3 EPA 1677
	Hardness	SM 2340B
Total and Dissolved Metals	See Appendix A-2 for complete list of total and dissolved metals analyzed	EPA 200.7, EPA 200.8 (selenium and thallium), EPA 245.1 (mercury, “liquid” samples), EPA 245.5 (mercury, “solids” samples)
Volatile and Semivolatile Organics	See Appendix A-2 for a complete list of volatile and semivolatile organics analyzed.	EPA 624 EPA 625
Pesticides	See Appendix A-2 for a complete list of organohalide and organophosphorus pesticides analyzed.	EPA 1656A EPA 1657A
Polychlorinated Biphenyls (PCBs)	See Appendix A-2 for complete list of PCBs analyzed.	EPA 1668A
Dioxins and Furans	See Appendix A-2 for complete list of dioxins and furans analyzed.	EPA 1613B

Table 3-4

Field Measurement Equipment, Island Princess

Parameter	Measured by:
pH	Four-color pH paper
Temperature	Alcohol thermometer
Conductivity and salinity	Portable conductivity/salinity meter (YSI Model 30)
Turbidity	Pocket turbidimeter (Hach Cat. No. 52600-00)
Sulfide	Colorimeter (Hach DR 890)
Free and total chlorine	Pocket colorimeter (Hach Cat. No. 46700-00)

Table 3-5

Deviations from the Sampling and Analysis Plan, Island Princess

Deviation	Description
Pathogen Indicators Laboratory Duplicates	For 5% of the pathogen indicators samples, duplicate 100-mL sample volumes were taken with the intention that the laboratory would composite the 100-mL sample volumes and then analyze duplicate samples from each composite sample to evaluate laboratory precision (i.e., laboratory duplicates). However, the laboratory did not prepare composites, but instead analyzed each of the 100-mL sample volumes individually. Accordingly, the results obtained from these analyses are field duplicate samples, not laboratory duplicates, and are presented and handled as such in this report. See Section 5.2.3 and Table 5-4 for details on duplicate sampling for pathogen indicators.
Laundry Wastewater (SP-2), Composite Samples	The strap-on flow meter set-up and calibration was unsuccessful at the laundry wastewater sampling point (the inlet pipe to the laundry wastewater holding tank), most likely due to poor pipe flow conditions such as pipe scaling or extreme aeration. As a result, flow data could not be collected at this sampling point. In addition, the flow meter could not be used to initiate collection of flow-weighted composite samples at SP-2 as described in the Island SAP. As an alternative sampling methodology, the automatic sampling machine was programmed to collect a time-weighted composite sample as described in Table 3-2. EPA conclude that the collected samples were respresentive of laundry wastewater as generated onboard the Island.
Laundry Wastewater (SP-2), Grab Samples	The sampling team successfully collected only one set of four planned grab and grab composite samples on Day 1 of sampling due to the inability to coordinate sample collection times with adequate wastewater volumes in the laundry holding tank. Sample volume from the single grab was sufficient for analysis of pathogen indicators, volatile organics, and total cyanide, but was not sufficient for analysis of HEM/SGT-HEM and available cyanide.
Effluent from Treatment (SP-6/7), Composite and Grab Samples	Composite by flow sampling at SP-6/7 was suspended on Day 3 from 0720 to 2115 because overboard discharge was restricted while the ship cruise Glacier Bay. (The flow meter that controlled composite by flow sample collection was located on the overboard discharge pipe, but during this time the effluent was diverted to storage in double-bottom holding tanks.) The four grab and grab composite sample collection times were adjusted to account for the suspended discharge as the sample tap was also located downstream of valve that diverts the treated effluent to the double-bottom holding tanks. See Appendices A-1 and A-3 for the grab and grab composite collection times, respectively.
Volatile Organics Preservation	Free chlorine was detected in pre-sampling field tests at all sampling points. Based on these results, the sampling team prepreserved all volatile organics sample vials with sodium thiosulfate rather than waiting to determine preservation requirements based on the free chlorine field test results. Free chlorine was generally detected in grab samples collected throughout the sampling episode. (Sample vials were also prepreserved with hydrochloric acid to control biological activity as discussed in the Island SAP.)

Table 3-5 (Continued)

Deviation	Description
Galley, Laundry, and Food Pulper Overboard Discharge (SP-8, SP-9, SP-10) and Waste Biosludge (SP-12)	During the pre-sampling set-up, the ship notified EPA that galley, laundry, and food pulper wastewater and waste biosludge would be discharged prior to docking in Whittier, Alaska (prior to the start of the sampling episode), and that these holding tanks would not be discharged again until after the 5-day sampling episode had ended. Discharge prior to entering Whittier was necessary since the ship would be greater than 12 nm from shore, and the crew needed wastewater storage capacity prior to embarking new passengers. Therefore, to characterize these four waste streams as discharged, samples were collected on August 26, 2004, approximately 1.5 days prior to the start of the sampling episode. These samples were then shipped to the appropriate laboratories from Whittier on August 28. Because the onboard pathogen indicators laboratory was not yet operating at the time of sample collection, pathogen indicator analyses for these samples were performed approximately 18 hours outside the required 6-hour holding time; the resulting data are not considered valid.
Food Pulper Overboard Discharge (SP-10) and Waste Biosludge (SP-12), Semivolatile Organics Analysis	The analytical laboratory notified EPA that the food pulper overboard discharge samples for semivolatile organics analysis were received broken. Therefore, the sampling team collected a second food pulper overboard discharge sample for semivolatile organics analysis on September 2, 2004 after the 5-day sampling episode had ended. Upon receipt and review of the laboratory data package, EPA discovered that the waste biosludge sample was broken and not the food pulper overboard discharge sample. As a result, the analytical database for the Island includes two sets of semivolatiles data for food pulper overboard discharge and no semivolatile data for waste biosludge. The second set of semivolatiles data for food pulper overboard discharge can be found in Appendix A-2.
Analytical Methods	EPA-contracted laboratories substituted comparable EPA analytical methods for certain analytes. Table 3-3 lists the actual analytical methods used by the laboratories. Note that while the Island SAP correctly listed EPA Methods 624 and 625 as the planned methods for analyzing for volatile and semivolatile organics, respectively, Appendix E of the Island SAP mistakenly listed the target analytes for EPA Methods 1624 and 1625. Appendix A-2 of this report presents the actual list of target volatile and semivolatile organics.
Sampling Schedule	The sampling team adjusted the sampling schedule in Appendix C of the Island SAP to accommodate sampling logistics and ship operations. Refer to Appendix A-3 of this report for actual samples collected and sample collection dates/times.

4.0 RESULTS AND DISCUSSION

This section presents the data collected during this sampling episode. Section 4.1 presents the analytical results and discussion; Section 4.2 presents interview results for activities that impact wastewater generation; and Section 4.3 presents flow data and analysis. Analytical results for field measurements performed onboard are presented in Appendix A-3. Note that anomalous analytical results were obtained for available and total cyanide; these data have not been excluded from the data set, but the results are presented in and discussed in Section 5.1.1 (in the data quality section of this report) and not in the current section.

4.1 Laboratory Analytical Results and Discussion

4.1.1 Graywater

Tables 4-1 through 4-3 present analytical results for galley, laundry, and accommodations wastewater, respectively, which were collected for five consecutive 24-hour sampling periods during the sampling episode. Table 4-4 presents average analytical concentrations for these three graywater sources. Only those analytes detected at least once in any of the wastewater samples (i.e., graywater sources, influent to treatment system, or effluent from treatment system) are included in this table. Appendices A-1 and A-2 present results for both detected and nondetected analytes.

Of the 295 analytes tested for in the graywater sources, 64 were detected in the graywater waste streams. Thirteen of these 64 analytes were also detected at some level in the equipment blank (flagged by an "e" in Tables 4-1 through 4-5; see Table 5-2 for equipment blank results), meaning that the sampling equipment may have contributed some or all of these analytes to the samples. EPA will consider the impact of possible contamination from sampling equipment in a future analysis. Twenty-one of these 64 detected analytes were also detected at some level in the potable water used as source water for all graywater systems (flagged by an "s" in Tables 4-1 through 4-5; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of these analytes to the samples.

Chart 1 presents the number of analytes detected in each graywater source (see Table 4-4).

Chart 1. Number of Analytes Detected in Graywater Sources

Analyte Group (a)	Number of Analytes Detected		
	Galley	Laundry	Accommodations
Pathogen Indicators	3	3	3
Classical Pollutants	15	15	15
Total and Dissolved Metals	40	31	34
Volatile and Semivolatile Organics	3	3	2
Total	**61**	**52**	**54**

(a) See Table 3-3 for information on analyte groups.

Chart 2 presents the number of analytes that were detected in each graywater source at the highest average concentration. For example, the highest average detected concentrations for all three pathogen indicators were found in the galley wastewater. Note that a graywater source that has the highest concentration of an analyte will not necessarily contribute the greatest amount of that analyte to the wastewater treatment system or overboard discharge. The total amount of an analyte contributed by a particular graywater source also will depend on that source's volume compared to the volumes of the other sources. Flow (and thus volume) information was not able to be collected for all graywater sources (see Table 2-1).

Chart 2. Number of Analytes Detected at Highest Average Concentration in Graywater

Analyte Group (a)	Number of Analytes Detected in Graywater	Number of Analytes Detected at the Highest Average Concentration		
		Galley	Laundry	Accommodations
Pathogen Indicators	3	3	0	0
Classical Pollutants	15	14	1	0
Total and Dissolved Metals	43	34	4	5
Volatile and Semivolatile Organics	3	2	1	0
Total	**64**	**53**	**6**	**5**

(a) See Table 3-3 for information on analyte groups.

Galley wastewater contained a total of 61 analytes and showed the second highest average concentrations for 53 analytes, including all pathogen indicators, most classical pollutants, and most organics. Galley wastewater showed the highest average concentration of several analytes commonly used to measure wastewater strength: all 3 pathogen indicators, biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), hexane extractable material (HEM), and total suspended solids (TSS). The galley wastewater was the only graywater source that was analyzed for pesticides because this was the most likely possible source of these analytes; none were detected.

Laundry wastewater contained a total of 52 analytes and showed the highest average concentrations for 6 analytes, including nitrate/nitrite, total silver, total and dissolved lead, total titanium, and chloroform. The laundry wastewater was the only graywater source that was analyzed for dioxins and furans because this was the most likely possible source of these analytes; none were detected.

Accommodations wastewater contained a total of 54 analytes and showed the highest average concentrations among the graywater sources for 5 analytes, including total aluminum, total beryllium, total and dissolved mercury, and total vanadium.

Galley, laundry, and food pulper wastewaters are collected into holding tanks and held for discharge untreated outside of 12 nm from shore. Table 4-5 presents analytical results for galley, laundry, and food pulper overboard discharge samples, which were collected as one-time grab samples as these wastewaters were discharged overboard. In general, the same pollutants were detected in the wastewaters as generated and during overboard discharge for both the galley and laundry wastewater. (System piping precluded collection of samples of food pulper wastewater as generated.) Variability in pollutant concentrations is likely caused by variations in wastewater generation over time rather than by changes in wastewater characteristics during wastewater storage.

4.1.2 Influent to Treatment System

Table 4-6 presents analytical results for the influent to the treatment system, which was sampled for five consecutive 24-hour sampling periods. Only those analytes detected at least once in any of the wastewater samples (i.e., graywater sources, influent to treatment system, or effluent from treatment system) are included in this table. Appendices A-1 and A-2 present results for both detected and non-detected analytes.

Pathogen Indicators and Classical Pollutants

All 3 pathogen indicators and all 16 classical analytes were detected in the influent to treatment samples. Three of these detected analytes were also detected at some level in the potable water used as source water for all graywater and sewage systems (flagged by an "s" in Table 4-6; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of these analytes to the samples. None of these analytes were detected in the equipment blank.

Wastewater conservation practices used onboard, such as use of vacuum toilets, result in highly concentrated wastewater. Chart 3 compares the influent to the Island treatment system to typical domestic wastewater for selected pathogen indicators and classical pollutants. Fecal coliform and enterococci concentrations in the influent to the Hamworthy treatment system were two or more orders of magnitude greater than in typical untreated domestic wastewater. Key analytes commonly used to assess wastewater strength, such as BOD_5, TSS, and COD, were detected at concentrations two or more times greater than typical domestic wastewater.

Chart 3. Comparison of Influent to Island Treatment System to Untreated Domestic Wastewater

Parameter	Untreated Island Wastewater	Untreated Domestic Wastewater (a)
Enterococci	10^6 to 10^7 MPN/100 mL	10^2 to 10^3 number/100 mL
Fecal Coliform	10^7 to 10^8 CFU/100 mL	10^4 to 10^5 number/100 mL
Ammonia	69.6 to 139 mg/L	12 to 50 mg/L
Biological Oxygen Demand (BOD_5)	224 to 409 mg/L	110 to 400 mg/L
Chemical Oxygen Demand (COD)	546 to 1,560 mg/L	250 to 1,000 mg
Nitrate/Nitrite	ND to 0.1 mg/L	0 mg/L
Oil and Grease	59.2 to 269 mg/L	50 to 150 mg/L
Total Phosphorus	16.6 to 71.6 mg/L	4 to 15 mg/L
Total Suspended Solids (TSS)	860 to 1,560 mg/L	100 to 350 mg/L

(a) Source: Metcalf & Eddy, *Wastewater Engineering*, Third Edition, 1991.
ND - Not detected.

Total and Dissolved Metals

Of the 35 metal analytes detected in the influent to treatment samples, 27 were detected in every influent to treatment sample (Table 4-6). Ten of these 35 metal analytes were detected at some level in the equipment blank (flagged by an "e" in Table 4-6; see Table 5-2 for equipment blank results), meaning that the sampling equipment may have contributed some or all of these analytes to the samples. EPA will consider the impact of possible contamination from equipment in a future analysis. Seventeen of these detected metal analytes were also detected at some level in the potable water used as source water for all graywater systems (flagged by an "s"in Table 4-6; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of these analytes to the samples.

The 10 metal analytes detected at the highest concentrations were: total and dissolved sodium, total and dissolved magnesium, total and dissolved calcium, total aluminum, total copper, total iron, and total zinc. Total chromium, total and dissolved copper, total lead, total mercury, total and dissolved nickel, total and dissolved selenium, and total and dissolved zinc are priority pollutant metals (designated by EPA in 40 CFR Part 423, Appendix A) that were detected in every influent to treatment sample. Some metals may result from contact with carbon steel and stainless steel pipes and tanks in the ship.

Volatile and Semivolatile Organics, Pesticides, PCBs

Among the 365 target analytes for volatile and semivolatile organics, pesticides, and polychlorinated biphenyls (PCBs), 42 were detected in any Island influent to treatment samples: 2 semivolatile organics, 3 volatile organics, 1 pesticide, and 36 PCBs (Table 4-6). Neither of the 2 detected semivolatile organics were detected in the equipment blank (see Table 5-2 for equipment blank results; volatile organics, pesticides, and PCBs were not analyzed for in the equipment blank). EPA will consider the impact of possible contamination from equipment in a future analysis.

Two semivolatile organics were detected in the influent to treatment: bis(2-ethylhexyl)phthalate and phenol. Bis(2-ethylhexyl)phthalate is used as a plasticizer (a chemical added to plastics to make them flexible) and is commonly detected in environmental samples (ATSDR, 2002). Cruise ships use a wide variety of plastic products (e.g., floor tiles, shower curtains, hoses, packaging materials and containers, PVC piping) that may result in the presence of bis(2-ethylhexyl)phthalate in the influent to treatment.

Phenol is both man-made and produced naturally. It is found in human wastes (urine), which is the most likely source for phenol's presence in the influent to the Island treatment system. It is also found in some foods (smoked summer sausage, fried chicken, mountain cheese, some species of fish). Man-made sources include the use of phenol as a slimicide, as a disinfectant, and in medicinal preparations such as ointments, ear and nose drops, and antiseptic wipes. (ATSDR, 1998) All of these are possible sources for the presence of phenol in cruise ship wastewater. Phenol was also detected in the source water (see Table 4-12 for source water results), meaning that the source water may have contributed some or all of this analyte to the samples.

Three volatile organics were detected in the influent to treatment: methylene chloride, toluene, and tetrachlorethene. Methylene chloride and toluene were each detected just above their respective detection limits in one of five influent to treatment system samples during the sampling episode. Methylene chloride is an industrial solvent commonly used in paint removers and degreasing agents; other uses include the production of photographic films,

pharmaceuticals, inks, and adhesives. Methylene chloride can also serve as a propellant for insecticides, air fresheners, and paints. (ATSDR, 2001) Toluene is a component of fuels made from crude oil; it is also a solvent used in the production of paints, paint thinners, adhesives, and rubbers (ATSDR, 2001). Methylene chloride and toluene were not detected in any of the accommodations wastewater samples; therefore, the source of these analytes may be the sewage CHT system.

Tetrachloroethene was detected in three of five influent to treatment system samples. Tetrachloroethene is a solvent used in metal cleaning and dry cleaning (ATSDR, 1997). The Island has a dry cleaning facility. According to the ship's crew, all tetrachloroethene wastes are collected for shoreside waste disposal. Tetrachloroethene was not detected in the accommodations wastewater (or any other graywater samples); therefore, the source may be the sewage CHT system.

Thirty-six PCB congeners and co-eluting congener groups were detected in the influent to the wastewater treatment system. Total PCBs in the influent were measured at a concentration of 37,100 pg/L. Two of the detected PCBs were identified as "toxic" by the World Health Organization: PCB 105 (406 pg/L) and PCB 118 (984 pg/L). PCBs have traditionally been associated with electrical equipment, such as transformers; however, they have also been used in paint formulations, carbonless copy paper and plastics (EPA, 2005). None of the detected PCBs have any known manufacturers. (Note that PCBs were not analyzed for in source water.)

Simazine was the only pesticide detected in the influent to the treatment system. EPA lists simazine as a General Use Pesticide (GUP) that has been used to control broad-leaved weeds and annual grasses in fields, berry fruit, and vegetables. Simazine is classified by EPA to be slightly toxic to practically non-toxic. In the past, simazine has been used to control algae in swimming pools, hot tubs, and whirlpools. (Extoxnet, 1996)

4.1.3 Influent to the Ultraviolet (UV) Disinfection Part of the Treatment System

Table 4-7 presents pathogen indicator results for the influent to UV disinfection part of the Island's wastewater treatment system. Grab samples for individual pathogen indicator analyses were collected for five consecutive 24-hour sampling periods. Pathogen indicators, which were generally in the millions at the influent to the treatment system (see Table 4-6), were generally reduced to nondetect or close to the detection limit after the bioreactor and membrane filter (i.e., before the UV disinfection step). Data for the pathogen indicators in the final effluent (i.e., after the UV disinfection step) are presented in the next section.

4.1.4 Effluent from the Treatment System

Table 4-8 presents analytical results for the effluent from treatment system, which was sampled for five consecutive 24-hour sampling periods. Only those analytes detected at least once in any of the wastewater samples (i.e., graywater sources, influent to treatment system, or effluent from treatment system) are included in this table. Appendices A-1 and A-2 present results for both detected and nondetected analytes.

Pathogen Indicators and Classical Pollutants

A total of 15 grab samples were collected for analysis of the three pathogen indicators over the five 24-hour sampling periods (results and collection times for each grab sample are presented in Appendix A-1). Pathogen indicators generally were not detected in the effluent from the treatment system; the exceptions to this were three grab samples in which *E. coli* was detected at levels close to the detection limit (one sample on Day 1 and two samples on Day 4), three grab samples in which enterococci was detected at levels close to the detection limit (Day 1, Day 4, and Day 5), and one grab sample in which fecal coliform was detected at 20 CFU/100 mL on Day 1 (detection limit is 2 CFU/100 mL).

Thirteen of the 16 classical pollutants were detected in effluent from treatment system samples; 3 classical pollutants (HEM, SGT-HEM, and settleable residue) were not

detected in any effluent samples. Three of the 13 detected classical analytes were also detected at some level in the potable water used as source water for all graywater and sewage systems (flagged by an "s" in Table 4-8; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of the analytes to the sample. None of these analytes were detected in the equipment blank.

Chart 4 shows that classical pollutant concentrations in the effluent from the Island treatment system are lower than EPA's standards for secondary treatment.

Chart 4. Classical Pollutant Comparison of Effluent from Island Treatment System to Secondary Treatment Standards

Classical Pollutant	Average Effluent from Island Treatment System	Secondary Treatment Standards (a)
Biochemical Oxygen Demand (BOD_5)	<3.46 mg/L	45 mg/L
Total Suspended Solids (TSS)	<7.70 mg/L	45 mg/L

(a) 40 CFR 133.102 Secondary Treatment Regulations, 7-day average.
< Average result includes at least one nondetect value (calculations uses detection limits for nondetected results).

Total and Dissolved Metals

Among the 54 total and dissolved metal analytes tested for, 31 were detected in one or more effluent from treatment samples (Table 4-8). Of these 31 detected metal analytes, 22 were detected in every effluent from treatment sample. Eight of the 31 detected metal analytes were also detected at some level in the equipment blank (flagged by an "e" in Table 4-8; see Table 5-2 for equipment blank results), meaning that the sampling equipment may have contributed some or all of this analyte to the samples. EPA will consider the impact of possible contamination from equipment in a future analyses. Seventeen of these detected metal analytes were also detected at some level in the potable water used as source water for all graywater and sewage systems (flagged by an "s" in Table 4-8; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of the analytes to the sample.

The 10 metal analytes detected at the highest concentrations were total and dissolved calcium, magnesium, sodium, zinc, and boron. Total and dissolved copper, nickel, selenium, zinc, and total mercury are priority pollutant metals (designated by EPA in 40 CRF

Part 423, Appendix A) that were detected in every effluent from treatment sample. Some metals may results from contact with carbon steel and stainless steel pipes and tanks in the ship. There are no EPA secondary treatment standards for metals.

Volatile and Semivolatile Organics, Pesticides, PCBs, Dioxins and Furans

Among the 84 target analytes for volatile and semivolatile organics analyzed, only two–phenol and bis(2-ethylhexyl)phthalate–were detected in any Island effluent samples (Table 4-8). Phenol is found in urine and bis(2-ethylhexyl)phthalate is used in plastics (see Section 4.1.2). Phenol was detected at some level in the potable water used as source water for all graywater and sewage systems (flagged by an "s" in Table 4-8; see Table 4-12 for source water results), meaning that the source water may have contributed some or all of the analyte to the sample.

Pesticides, PCBs, and dioxins and furans were not analyzed for in the effluent from the treatment system.

4.1.5 Wastewater Treatment System Performance: Comparison of Influent to Treatment System and Effluent from Treatment System

The Hamworthy treatment system successfully removed almost all pathogen indicators (>99%; Table 4-9) and most classical pollutants, metals, and organics (Tables 4-9 and 4-10).

Pathogen Indicators and Classical Pollutants

Pathogen indicators were generally removed by the bioreactor and membrane filters to levels below detection (>99% removal), while any remaining indicators were generally removed by UV disinfection (overall system efficiency >99%, see Table 4-9). Enterococci and *E. coli* were each detected in 3 of the 15 effluent from treatment samples at levels close to the detection limit; fecal coliform was detected in 1 of the 15 samples.

The treatment system removed almost all biochemical oxygen demand (BOD_5) (99%), and most chemical oxygen demand (COD) (93%) and total organic carbon (TOC) (89%) (Table 4-10). The system also removed almost all settleable residue and total suspended solids (TSS) (both 99% or greater). Oils and greases (HEM and SGT-HEM) were removed to levels below detection.

The treatment system reduced ammonia by 58%, while reducing total Kjeldahl nitrogen (TKN, which measures both ammonia and organic forms of nitrogen) and total phosphorus by approximately 75% (Table 4-10). Nitrate/nitrite levels are low and remained relatively unchanged. Nitrogen is likely taken up by the microorganisms in the bioreactor and removed from the system in the waste biosludge. It is unlikely that nitrogen is removed by nitrification (the mechanism of ammonia biodegradation) as nitrification would have resulted in an increase in nitrate/nitrite concentration, but these levels remained relatively unchanged. Phosphorus also is most likely taken up by the microorganisms in the bioreactor as evidenced by elevated total phosphorus concentrations in the waste biosludge (see Section 4.1.6 and Table 4-11).

Total and Dissolved Metals

The total metals analysis measures both the particulate and dissolved forms of metals, while the dissolved metals analysis measures only the dissolved form. The difference between the total and dissolved metals measurements is the particulate metals concentration. Metals were present in both particulate and dissolved forms in the influent to the treatment system (i.e., the total metals concentrations exceeded the dissolved metals concentrations for most metal analytes) (Table 4-6). In comparison, metals were predominantly present in the dissolved form in the effluent from the treatment system (i.e., the total and dissolved metals concentrations were similar in these samples) (Table 4-8). Furthermore, there were elevated metals concentrations in the screening solids and waste biosludge (see Table 4-11). This means that the treatment system is highly efficient in removing particulate metals, as would be expected for membrane filtration (and as supported by $\geq$99% removal of settleable residue and TSS, see Table 4-8). The treatment systems removed dissolved metals with an average efficiency of 37% (Table 4-10).

Volatile and Semivolatile Organics, Pesticides, PCBs, Dioxins and Furans

The treatment system was able to remove most of the volatile and semivolatile organic compounds to levels below detection (Table 4-10). Possible removal mechanisms include biological degradation, adsorption onto wastewater treatment sludge (see Table 4-11), and/or volatilization.

Simazine was the only pesticide detected in the influent to treatment, and pesticides were not analyzed for in the effluent from treatment. While PCBs were detected in the influent to treatment, they were not analyzed for in the effluent from treatment. EPA has no data regarding the performance of the Hamworthy treatment system for removing pesticides and PCBs. Dioxins and furans were not analyzed for in either the influent to or effluent from the treatment system. Dioxins and furans were analyzed for in laundry wastewater, and none were detected.

4.1.6 Screening Solids, Waste Biosludge, and Incinerator Ash

Table 4-11 presents the results for analytes detected in one-time grab samples of screening solids (from screens presses at the beginning of the treatment system), waste biosludge (excess biological mass from the treatment system's bioreactor), and incinerator ash (from incineration of trash, screening solids, and spent bag filters) collected during the sampling episode. Table 4-11 also shows the average influent to treatment analyte concentrations from Table 4-10 for comparison.

Most of the analytes detected in the screening solids and waste biosludge were also detected in the influent to treatment. For many analytes, concentrations in the screening solids and waste biosludge exceeded those in the influent to treatment, suggesting that these analytes are removed from the system in these waste streams. See Section 4.1.5 for a detailed discussion of wastewater treatment system performance.

4.1.7 Source Water

Potable water is used as source water for all ship operations that generate graywater and sewage (e.g., laundry, galley, food pulper, sinks, showers, and toilets). Potable water is produced onboard and bunkered while in port, with produced water providing approximately two-thirds of freshwater requirements and bunkered water providing approximately one-third of freshwater requirements. Seven total metals, 11 dissolved metals, 3 classical pollutants, and 1 organic were detected in the one-time grab sample of potable water collected during this sampling episode (Table 4-12). None of the analytes detected in the source water exceeded Federal drinking water standards (Table 4-12). Pathogen indicators were not detected in the source water sample.

4.2 Summary of Interviews Regarding Activities that Impact Wastewater Generation

The ship's crew was interviewed to obtain information regarding activities that impact wastewater generation (see Appendix C for detailed reports). The ship's crew provided operational, discharge, and wastewater treatment operating logs corresponding to the period of the sampling episode. These documents are included in the Cruise Ship Rulemaking Record and are available upon request.

4.2.1 Wastewater Generation

Galley

The Island has two main dining rooms, four additional restaurants, and 24-hour room service. Approximately 10,000 meals (breakfast, lunch, dinner, and snacks) are served daily. The ship's ten main automatic washing machines operate 24-hours a day. Dishes are washed using Solid Power and Super Trump (high alkaline solid automatic dishmachine detergents). Floors are washed using Encomp cleaning solution. Material Safety Data Sheets (MSDS) for these products are included in the Cruise Ship Rulemaking Record and are available upon request.

Laundry

The Island operates one large continuous tunnel washer to wash towels and linens from approximately 0800 to 1500 and 2000 to 0100 each day. Cleaning agents (Laundri SL-2000 and Eco-Star Detergent 1) are dispensed automatically using a computer-controlled menu depending on the material and degree of soiling. The Island operates two large washing machines to wash blankets (total of 10 loads per day at 300 pound capacity each) and two small washing machines (50 pound capacity) to wash passengers' personal items (operate from approximately 2000 to 0600 each day). MSDS for laundry cleaning agents are included in the Cruise Ship Rulemaking Record and are available upon request. Finally, the Island has six passenger laundrettes and six crew and officer laundrettes, processing approximately 40 pounds of laundry per load.

Photo Processing

The Island has an onboard photo processing lab with all digital photo processing equipment. All waste photographic chemicals are collected into drums for disposal onshore. The drums are stored within secondary containment to capture any spills. The sink in the photo lab drains to a drum for disposal onshore. The photo lab has two floor drains that are capped to ensure that spilled chemicals do not enter the drain system. Any spills are captured in in-room storage containers for shore disposal.

Print Shop

The Island houses a print shop. The floor drain is capped and any spills are captured in an in-room storage container for shore disposal. The print shop sink drains to a drum for onshore disposal. All print shop wastes (cleaning rags with solvents and chemical residues) are disposed of as hazardous waste onshore.

Dry Cleaning

The Island has a dry cleaning facility. One Renzacci dry cleaning machine processes approximately five loads per day using auto-distillation of solvent. This machine generated five liters of spent solvent during the first seven months of 2004; spent solvent is disposed of onshore as hazardous waste. Dry cleaning wastewater (condensate separator water) is routed to the laundry CHT system. Two Aquatex machines process approximately 15 loads per day using a water-based chemical which produces non-hazardous waste, according to the crew. Aquatex wastewater and lint waste is routed to the laundry CHT systems. No sinks or floor drains are present in the dry cleaning facility.

Chemical Storage

Any spills from the engine room storage areas are captured in the bilge and do not enter the graywater or sewage systems. See Appendix C for more information on chemicals stored in each engine room. Chemicals are also stored in other rooms of the ship as listed in Appendix C; none of the storage rooms have floor drains to ensure that spilled chemicals do not enter the graywater and sewage systems.

Medical Infirmary

The Island has a medical infirmary. Water that enters the floor drain or sinks drains to the graywater system; there is no floor drain in the digital imaging room. Sinks are used for handwashing only; the crew indicated that no chemicals are disposed of in the sinks. Any wastes are collected by the environmental officer for onshore disposal.

4.2.2 Pesticide, Fungicide, and Rodenticide Use

The Island uses Siege Gel insecticide bait (active ingredient hydamethylnon) and Maxforce bait stations (active ingredient fipronil) to control insect pests. Aerosol insecticides used onboard include Cy-kick (active ingredient cyfluthron) and 565 Plus XLO (active

ingredients pyrethrins and allethrin). MSDS for insect control agents are included in the Cruise Ship Rulemaking Record and are available upon request. The pesticide Simazine was detected in one Island influent to treatment sample. Simazine is a selective herbicide used to control weeds and grasses in food and feed crops; it is also widely used for nonselective weed control in industrial areas. In the past, Simazine was used to control submerged weeds and algae in large aquariums and swimming pools. (Extoxnet, 1996)

Victor glue traps are set up to catch rodents. The Island does not use fungicides or rodenticides onboard.

4.3 Flow Data

Strap-on ultrasonic flow meters were used to collect flow measurements and to control automatic composite sample machines on (1) the outlet from the crew galley collection tank, (2) the outlet from one of the accommodations wastewater collection tanks, (3) the influent to wastewater treatment, (4) and the effluent from wastewater treatment (see Section 2.4 and Figures 2-1 and 2-2). The flow meters were programmed to record the instantaneous flow rate (m^3/min) and total flow (m^3) every five minutes. Flow data analyses presented in this section are based on only those flow data collected during the sampling episode of August 28 through September 2. Appendix B presents all flow data collected while onboard the Island from August 23 through September 3.

The flow meters on the outlet pipes from the galley and accommodations collection tanks recorded large negative flows when the tank discharge pumps were not operating, indicating significant backflow through these systems. Accordingly, the recorded flows do not accurately represent galley and accommodations wastewater generation at these locations and are not described further in this report.

The total daily volume of influent to and effluent from the treatment system for each 24-hour sampling period are presented in Figure 4-1. The influent to the treatment system flow was, on average, 75 percent of the flow measured from the effluent from the treatment system. One possible explanation is that the ultrasonic signal to the flow meter at the influent to

treatment system was weakened (or scattered) by the amount of solids present in the raw wastewater flowing through the pipe. A comparison of the average hourly flows indicates that the influent and effluent discharge flow rates show similar fluctuation throughout the day. Therefore, the flow measurements collected from the influent to the treatment are probably valid for qualitative use. The total daily flow from the influent remained relatively constant over the five-day sampling period, regardless of whether the ship was in port (Days 1, 4, and 5) or at sea (Days 2 and 3).

The Island discontinued discharge of effluent from the treatment system for part of Day 3 of this sampling episode (while it cruised Glacier Bay National Park) and diverted the wastewater to a holding tank for overboard discharge outside of 12 nm of shore, as can be seen by the dip in the total daily effluent discharge on Day 3. Daily effluent flow rates and flow per capita are presented in Table 4-13. Per capita flow rates were calculated based on 2,925 people (2,019 passengers and 906 crew) onboard during the sampling episode, as reported by the ship's crew. On average, each person generated approximately 41 gallons of treated wastewater per person per day. It is important to note that the treatment system treats only accommodations wastewater and sewage. The flow measurements do not reflect other activities that occur onboard such as wastewater generated by the galley (galley and food pulper wastewater) and laundry.

Figure 4-2 presents the average effluent from treatment flow for each hour interval over the five consecutive 24-hour sampling periods, calculated from data collected via the strap-on flow meter. The highest rate of overboard discharge occurs between the hours of 2100 and 0400.

Table 4-1

Galley Wastewater Analytical Results, Island Princess

Analytical results for galley wastewater for analytes detected at least once in wastewater samples during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Galley wastewater samples were collected for five consecutive 24-hour periods; see Section 3.2 for the sample collection methodology. Table 2-1 lists the specific wastewater streams in galley wastewater, and Figure 2-1 identifies the sampling point location. Average galley wastewater concentrations determined from the daily results. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Galley (SP-1) (a) Day1	Galley (SP-1) (a) Day2	Galley (SP-1) (a) Day3	Galley (SP-1) (a) Day4	Galley (SP-1) (a) Day5	Average Galley (SP-1) (a)
Pathogen Indicator Analyses								
E. coli (b)	MPN/100 mL		65,300 [N=2]	2,200,000 [N=2]	1,730,000 [N=2]	210,000 [N=2]	65,700 [N=2]	854,000
Enterococci (b)	MPN/100 mL		31,900 [N=2]	>1,360 [N=2]	14,100 [N=2]	21,800 [N=2]	250 [N=2]	>13,900
Fecal Coliform (b)	CFU/100 mL		6,350,000 [N=2]	56,000,000 [N=2]	455,000,000 [N=2]	550,000 [N=2]	590,000 [N=2]	104,000,000
Classical Pollutants								
Alkalinity	mg/L		156	72.0	124	ND(10.0)	171	<107
Ammonia As Nitrogen (NH3-N) (s)	mg/L		1.09	0.840	49.0	3.48	1.14	11.1
Biochemical Oxygen Demand (BOD_5)	mg/L		919	803	1,050	4,860	EXCLUDE	1,910
Chemical Oxygen Demand (COD)	mg/L		1,830	1,890	1,140	5,760	2,550	2,630
Chloride	mg/L		178	110	1,460	190	90.0	406
Hardness (s)	mg/L		42.0	38.1	503	87.3	54.0	145
Hexane Extractable Material (HEM)	mg/L		212	238	236	270	440	279
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		0.100	0.100	ND(0.0500)	ND(0.0500)	0.120	<0.0840
Settleable residue	mL/L		4.00	1.60	0.200	61.0	EXCLUDE	16.7
Silica Gel Treated HEM (SGT-HEM)	mg/L		ND(4.90)	ND(4.80)	ND(5.00)	ND(5.10)	ND(5.00)	ND(4.96)

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-1 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley (SP-1) (a) Day1	Galley (SP-1) (a) Day2	Galley (SP-1) (a) Day3	Galley (SP-1) (a) Day4	Galley (SP-1) (a) Day5	Average Galley (SP-1) (a)
Sulfate	mg/L		73.0	57.0	216	20.0	111	95.4
Total Dissolved Solids (TDS)	mg/L		1,290	788	3,420	2,010	1,090	1,720
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		37.1	29.8	90.6	126	28.2	62.3
Total Organic Carbon (TOC)	mg/L		392	275	297	1,200	333	499
Total Phosphorus	mg/L		4.10	15.2	13.3	36.4	50.0	23.8
Total Suspended Solids (TSS)	mg/L		262	266	248	3,720	400	979
Total and Dissolved Metals								
Aluminum, Total	ug/L		806	3,300	263	811	1,000	1,240
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)
Barium, Total (e)	ug/L		56.0	34.0	12.0	23.0	48.2	34.6
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)
Boron, Total	ug/L		ND(3.37)	ND(3.37)	434	207	139	<157
Cadmium, Total	ug/L	P118	ND(0.446)	ND(0.446)	1.00	0.580	ND(0.446)	<0.584
Calcium , Total (s)	ug/L		12,300	11,800	46,000	23,500	16,800	22,100
Chromium, Total	ug/L	P119	11.0	7.00	ND(1.68)	7.20	9.50	<7.28
Cobalt, Total	ug/L		ND(0.914)	ND(0.914)	1.00	ND(0.914)	ND(0.914)	<0.931
Copper, Total (s)	ug/L	P120	452	852	152	807	836	620
Iron, Total	ug/L		813	842	367	918	574	703
Lead, Total (e)	ug/L	P122	8.00	6.00	ND(3.08)	9.50	7.90	<6.90
Magnesium, Total (s)	ug/L		2,740	2,100	94,200	6,960	2,930	21,800
Manganese, Total (e)	ug/L		32.0	31.0	40.0	81.0	21.9	41.2

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-1 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley (SP-1) (a) Day1	Galley (SP-1) (a) Day2	Galley (SP-1) (a) Day3	Galley (SP-1) (a) Day4	Galley (SP-1) (a) Day5	Average Galley (SP-1) (a)
Mercury, Total (e) (s)	ug/L	P123	ND(0.0170)	ND(0.0170)	ND(0.0170)	0.210	0.150	<0.0822
Nickel, Total	ug/L	P124	28.0	28.0	22.0	34.2	22.9	27.0
Selenium, Total (s)	ug/L	P125	1.00	1.00	70.0	2.90	1.30	15.2
Silver, Total	ug/L	P126	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)
Sodium, Total (s)	ug/L		256,000	126,000	788,000	181,000	192,000	309,000
Thallium, Total	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	0.0200	0.0100	<0.0114
Tin, Total	ug/L		13.0	8.00	5.00	31.6	70.9	25.7
Titanium, Total	ug/L		6.00	4.00	ND(0.253)	2.00	5.00	<3.45
Vanadium, Total	ug/L		ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Total (e) (s)	ug/L	P128	1,030	644	587	2,160	1,010	1,090
Aluminum, Dissolved	ug/L		723	910	159	600	523	583
Barium, Dissolved (e)	ug/L		22.2	7.70	10.6	13.8	24.2	15.7
Boron, Dissolved	ug/L		ND(3.37)	ND(3.37)	417	ND(3.37)	ND(3.37)	<86.1
Calcium, Dissolved (s)	ug/L		10,700	9,170	44,000	20,800	13,600	19,700
Chromium, Dissolved	ug/L	P119	4.90	2.10	ND(1.68)	2.50	5.50	<3.34
Cobalt, Dissolved (s)	ug/L		2.90	6.40	3.50	6.40	5.00	4.84
Copper, Dissolved (e) (s)	ug/L	P120	400	726	99.8	467	700	479
Iron, Dissolved (s)	ug/L		535	281	270	286	429	360
Lead, Dissolved (e)	ug/L	P122	6.70	3.20	ND(3.08)	ND(3.08)	8.70	<4.95
Magnesium, Dissolved (s)	ug/L		2,670	1,850	90,600	6,100	2,920	20,800
Manganese, Dissolved (e) (s)	ug/L		22.7	20.2	8.30	9.80	23.9	17.0

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-1 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley (SP-1) (a) Day1	Galley (SP-1) (a) Day2	Galley (SP-1) (a) Day3	Galley (SP-1) (a) Day4	Galley (SP-1) (a) Day5	Average Galley (SP-1) (a)
Mercury, Dissolved (e) (s)	ug/L	P123	0.0300	0.0300	0.0400	0.120	0.0900	0.0620
Nickel, Dissolved (s)	ug/L	P124	26.4	22.5	21.5	30.0	21.2	24.3
Selenium, Dissolved	ug/L	P125	1.00	1.00	70.0	2.90	1.50	15.3
Sodium, Dissolved (s)	ug/L		248,000	123,000	746,000	171,000	184,000	294,000
Thallium, Dissolved (e)	ug/L	P127	0.0100	ND(0.00900)	0.0100	0.0100	ND(0.00900)	<0.00960
Tin, Dissolved	ug/L		9.00	4.80	ND(3.45)	7.20	50.7	<15.0
Titanium, Dissolved	ug/L		5.20	ND(0.253)	ND(0.253)	ND(10.0)	ND(10.0)	<5.14
Vanadium, Dissolved	ug/L		1.40	2.90	1.80	ND(0.679)	ND(0.679)	<1.49
Zinc, Dissolved (e) (s)	ug/L	P128	864	617	496	1,880	923	956
Volatile and Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	271	201	ND(10.0)	170	350	<200
Chloroform	ug/L	P023	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	13.7	<10.7
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	90.9	125	89.7	96.9	85.1	97.5
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Pesticides								
Simazine	ug/L		NC	NC	ND(8.00)	NC	NC	ND(8.00)

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-2

Laundry Wastewater Analytical Results, Island Princess

Analytical results for laundry wastewater for analytes detected at least once in wastewater samples during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Laundry wastewater samples were collected for five consecutive 24-hour periods; see Section 3.2 for the sample collection methodology. Table 2-1 lists the specific wastewater streams in laundry wastewater, and Figure 2-1 identifies the sampling point location. Average laundry wastewater concentrations determined from the daily results. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Laundry (SP-2) (a) Day 1	Laundry (SP-2) (a) Day 2	Laundry (SP-2) (a) Day 3	Laundry (SP-2) (a) Day 4	Laundry (SP-2) (a) Day 5	Average Laundry (SP-2) (a)
Pathogen Indicator Analyses								
E. coli (b)	MPN/100 mL		ND(1.00) [N=1]	ND(5.50) [N=2]	ND(1.00) [N=2]	< 1.50 [N=2]	<104 [N=2]	<22.5
Enterococci (b)	MPN/100 mL		1.00 [N=1]	ND(5.50) [N=2]	ND(1.00) [N=2]	# 1,210 [N=2]	# 1,210 [N=2]	#486
Fecal Coliform (b)	CFU/100 mL		ND(2.00) [N=1]	<140 [N=2]	<57.5 [N=2]	<276 [N=2]	<4,350 [N=2]	<965
Classical Pollutants								
Alkalinity	mg/L		51.0	78.0	57.0	62.0	63.0	62.2
Ammonia As Nitrogen (NH3-N) (s)	mg/L		5.30	0.320	0.200	0.400	0.250	1.29
Biochemical Oxygen Demand (BOD_5)	mg/L		73.1	68.5	149	110	EXCLUDE	100
Chemical Oxygen Demand (COD)	mg/L		300	442	366	444	350	380
Chloride	mg/L		34.0	27.0	36.0	44.0	26.0	33.4
Hardness (s)	mg/L		23.3	20.4	21.0	21.8	39.3	25.2
Hexane Extractable Material (HEM)	mg/L		NC	7.50	9.40	5.60	8.40	7.73
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		0.120	0.170	0.120	0.150	0.190	0.150

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with a minimum of one and a maximum of two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-2 (Continued)

Analyte	Unit	Priority Pollutant Code	Laundry (SP-2) (a) Day 1	Laundry (SP-2) (a) Day 2	Laundry (SP-2) (a) Day 3	Laundry (SP-2) (a) Day 4	Laundry (SP-2) (a) Day 5	Average Laundry (SP-2) (a)
Settleable residue	mL/L		ND(0.100)	0.300	5.60	0.900	EXCLUDE	<1.73
Silica Gel Treated HEM (SGT-HEM)	mg/L		NC	ND(4.40)	ND(5.00)	ND(4.90)	ND(5.20)	ND(4.88)
Sulfate	mg/L		22.0	19.0	22.0	19.0	21.0	20.6
Total Dissolved Solids (TDS)	mg/L		218	248	298	304	211	256
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		ND(20.0)	6.30	5.10	8.60	4.50	<8.90
Total Organic Carbon (TOC)	mg/L		54.4	98.6	76.0	98.0	66.6	78.7
Total Phosphorus	mg/L		6.00	6.50	11.4	10.7	6.90	8.30
Total Suspended Solids (TSS)	mg/L		56.0	66.0	80.0	63.0	46.0	62.2
Total and Dissolved Metals								
Aluminum, Total	ug/L		167	155	187	209	111	166
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)
Barium , Total (e)	ug/L		17.0	15.0	17.0	30.7	33.0	22.5
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0504)
Boron, Total	ug/L		ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)
Cadmium, Total	ug/L	P118	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)
Calcium, Total (s)	ug/L		7,900	7,390	7,630	8,000	13,600	8,904
Chromium, Total	ug/L	P119	3.00	3.00	12.0	5.30	1.80	5.02
Cobalt, Total	ug/L		ND(0.914)	ND(0.914)	1.00	ND(0.914)	ND(0.914)	<0.931

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with a minimum of one and a maximum of two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-2 (Continued)

Analyte	Unit	Priority Pollutant Code	Laundry (SP-2) (a) Day 1	Laundry (SP-2) (a) Day 2	Laundry (SP-2) (a) Day 3	Laundry (SP-2) (a) Day 4	Laundry (SP-2) (a) Day 5	Average Laundry (SP-2) (a)
Copper, Total (s)	ug/L	P120	261	304	298	484	277	325
Iron, Total	ug/L		120	164	460	319	86.1	230
Lead, Total (e)	ug/L	P122	3.40	5.00	26.0	18.8	6.20	11.9
Magnesium, Total (s)	ug/L		861	470	474	453	1,290	710
Manganese, Total (e)	ug/L		3.00	3.00	7.00	4.70	2.10	3.96
Mercury, Total (e) (s)	ug/L	P123	0.0300	0.0400	0.0300	0.150	0.170	0.084
Nickel, Total	ug/L	P124	7.00	7.00	11.0	10.1	4.20	7.86
Selenium, Total (s)	ug/L	P125	4.00	ND(0.572)	ND(0.572)	0.610	ND(0.572)	<1.27
Silver, Total	ug/L	P126	3.00	3.00	7.00	6.20	ND(1.28)	<4.10
Sodium, Total (s)	ug/L		43,000	51,800	50,600	59,200	37,100	48,300
Thallium, Total	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Total	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Total	ug/L		ND(0.253)	4.00	7.00	6.10	7.50	<4.97
Vanadium, Total	ug/L		ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Total (e) (s)	ug/L	P128	481	328	685	510	348	470
Aluminum, Dissolved	ug/L		97.2	ND(9.93)	ND(9.93)	95.3	50.5	<52.6
Barium, Dissolved (e)	ug/L		12.2	5.80	3.70	6.50	24.5	10.5
Boron, Dissolved	ug/L		ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with a minimum of one and a maximum of two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-2 (Continued)

Analyte	Unit	Priority Pollutant Code	Laundry (SP-2) (a) Day 1	Laundry (SP-2) (a) Day 2	Laundry (SP-2) (a) Day 3	Laundry (SP-2) (a) Day 4	Laundry (SP-2) (a) Day 5	Average Laundry (SP-2) (a)
Calcium, Dissolved (s)	ug/L		7,270	6,660	6,170	7,080	13,100	8,060
Chromium, Dissolved	ug/L	P119	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)
Cobalt, Dissolved (s)	ug/L		3.00	2.70	2.90	2.50	2.30	2.68
Copper, Dissolved (e) (s)	ug/L	P120	193	202	212	392	213	242
Iron, Dissolved (s)	ug/L		ND(19.8)	ND(19.8)	ND(19.8)	61.1	45.9	<33.3
Lead, Dissolved (e)	ug/L	P122	5.70	ND(3.08)	8.80	6.50	3.90	<5.60
Magnesium, Dissolved (s)	ug/L		816	433	408	421	1,270	670
Manganese, Dissolved (e) (s)	ug/L		5.10	4.90	6.30	6.00	4.70	5.40
Mercury, Dissolved (e) (s)	ug/L	P123	0.0200	0.0500	0.0500	0.110	0.160	0.0780
Nickel, Dissolved (s)	ug/L	P124	4.80	3.30	5.70	5.10	4.60	4.70
Selenium, Dissolved	ug/L	P125	0.860	0.600	ND(0.572)	0.660	0.800	<0.689
Sodium, Dissolved (s)	ug/L		42,600	51,900	49,000	59,000	36,800	47,900
Thallium, Dissolved (e)	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Dissolved	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Dissolved	ug/L		ND(0.253)	ND(0.253)	ND(0.253)	ND(10.0)	ND(10.0)	ND(4.15)
Vanadium, Dissolved	ug/L		ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Dissolved (e) (s)	ug/L	P128	324	204	535	355	277	339

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with a minimum of one and a maximum of two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-2 (Continued)

Analyte	Unit	Priority Pollutant Code	Laundry (SP-2) (a) Day 1	Laundry (SP-2) (a) Day 2	Laundry (SP-2) (a) Day 3	Laundry (SP-2) (a) Day 4	Laundry (SP-2) (a) Day 5	Average Laundry (SP-2) (a)
Volatile and Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	75.4	120	113	102	52.4	92.6
Chloroform	ug/L	P023	94.9	90.7	106	129	86.1	101
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	133	73.8	101	84.6	73.6	93.2
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with a minimum of one and a maximum of two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-3

Accommodations Wastewater Analytical Results, Island Princess

Analytical results for accommodations wastewater for analytes detected at least once in wastewater samples during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Accommodations wastewater samples were collected for five consecutive 24-hour periods; see Section 3.2 for the sample collection methodology. Table 2-1 lists the specific wastewater streams in accommodations wastewater, and Figure 2-1 identifies the sampling point location. Average accommodations wastewater concentrations determined from the daily results. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Accommodations (SP-3) (a) Day 1	Accommodations (SP-3) (a) Day 2	Accommodations (SP-3) (a) Day 3	Accommodations (SP-3) (a) Day 4	Accommodations (SP-3) (a) Day 5	Average Accommodations (SP-3) (a)
Pathogen Indicator Analyses								
E. coli (b)	MPN/100 mL		< 150 [N=2]	< 83,500 [N=2]	< 521 [N=2]	< 1,920 [N=2]	7.30 [N=2]	<17,200
Enterococci (b)	MPN/100 mL		> 1,210 [N=2]	> 1,640 [N=2]	> 1,410 [N=2]	22.5 [N=2]	< 555 [N=2]	#966
Fecal Coliform (b)	CFU/100 mL		190,000 [N=2]	355,000 [N=2]	285,000 [N=2]	< 43,000 [N=2]	3,300 [N=2]	<175,000
Classical Pollutants								
Alkalinity	mg/L		73.0	126	96.0	63.0	91.0	89.8
Ammonia As Nitrogen (NH3-N) (s)	mg/L		0.680	0.330	0.400	0.340	0.400	0.430
Biochemical Oxygen Demand (BOD_5)	mg/L		158	144	170	109	EXCLUDE	145
Chemical Oxygen Demand (COD)	mg/L		331	408	332	1,050	340	492
Chloride	mg/L		15.0	20.0	15.0	12.0	19.0	16.2
Hardness (s)	mg/L		24.7	22.6	20.4	20.7	36.9	25.1
Hexane Extractable Material (HEM)	mg/L		17.3	21.2	10.1	16.2	15.8	16.1
Nitrate/Nitrite (NO2-N+ NO3-N)	mg/L		0.0500	0.100	ND(0.0500)	ND(0.0500)	0.100	<0.0700
Settleable Residue	mL/L		1.30	0.500	ND(0.100)	0.230	EXCLUDE	<0.533

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g., [N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Accommodations (SP-3) (a) Day 1	Accommodations (SP-3) (a) Day 2	Accommodations (SP-3) (a) Day 3	Accommodations (SP-3) (a) Day 4	Accommodations (SP-3) (a) Day 5	Average Accommodations (SP-3) (a)
Silica Gel Treated HEM (SGT-HEM)	mg/L		ND(4.90)	ND(4.80)	ND(4.70)	ND(5.00)	ND(4.40)	ND(4.76)
Sulfate	mg/L		18.0	30.0	13.0	11.0	13.0	17.0
Total Dissolved Solids (TDS)	mg/L		226	284	221	142	214	217
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		4.20	9.80	6.40	5.90	7.80	6.82
Total Organic Carbon (TOC)	mg/L		66.9	65.4	53.8	34.2	44.8	53.0
Total Phosphorus	mg/L		1.31	0.700	0.580	0.360	0.880	0.766
Total Suspended Solids (TSS)	mg/L		66.0	102	102	66.0	80.0	83.2
Total and Dissolved Metals								
Aluminum, Total	ug/L		4,820	10,700	7,070	3,890	9,080	7,110
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)
Barium, Total (e)	ug/L		17.0	17.0	14.0	10.8	33.9	18.5
Beryllium, Total (e)	ug/L	P117	0.190	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	<0.0812
Boron, Total	ug/L		ND(3.37)	ND(3.37)	ND(3.37)	169	266	<89.0
Cadmium, Total	ug/L	P118	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)
Calcium, Total (s)	ug/L		8,290	7,690	7,120	7,490	12,800	8,680
Chromium, Total	ug/L	P119	2.00	4.00	3.00	ND(1.68)	4.80	<3.10
Cobalt, Total	ug/L		ND(0.914)	1.00	ND(0.914)	ND(0.914)	ND(0.914)	<0.931
Copper, Total (s)	ug/L	P120	413	713	387	640	745	580
Iron, Total	ug/L		259	170	163	118	183	179
Lead, Total (e)	ug/L	P122	6.00	5.00	5.00	4.00	8.80	5.76
Magnesium, Total (s)	ug/L		966	819	646	495	1,190	823

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g., [N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Accommodations (SP-3) (a) Day 1	Accommodations (SP-3) (a) Day 2	Accommodations (SP-3) (a) Day 3	Accommodations (SP-3) (a) Day 4	Accommodations (SP-3) (a) Day 5	Average Accommodations (SP-3) (a)
Manganese, Total (e)	ug/L		11.0	7.00	5.00	3.50	6.10	6.52
Mercury, Total (e) (s)	ug/L	P123	0.0400	0.0400	0.0700	0.160	0.170	0.0960
Nickel, Total	ug/L	P124	14.0	10.0	11.0	13.5	13.4	12.4
Selenium, Total (s)	ug/L	P125	1.00	ND(0.572)	ND(0.572)	0.580	0.640	<0.673
Silver, Total	ug/L	P126	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)
Sodium, Total (s)	ug/L		40,300	71,400	50,000	33,700	46,600	48,400
Thallium, Total	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Total	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Total	ug/L		3.00	13.0	4.00	ND(0.253)	4.50	<4.95
Vanadium, Total	ug/L		1.00	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	<0.743
Zinc, Total (e) (s)	ug/L	P128	940	346	601	647	486	604
Aluminum, Dissolved	ug/L		350	287	265	190	221	263
Barium, Dissolved (e)	ug/L		ND(0.0970)	0.560	0.860	ND(0.0970)	ND(0.0970)	<0.342
Boron, Dissolved	ug/L		ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)	ND(3.37)
Calcium, Dissolved (s)	ug/L		5,200	2,200	2,820	4,620	6,610	4,290
Chromium, Dissolved	ug/L	P119	ND(1.68)	2.20	1.90	ND(1.68)	3.40	<2.17
Cobalt, Dissolved (s)	ug/L		ND(0.914)	ND(0.914)	ND(0.914)	2.80	1.80	<1.47
Copper, Dissolved (e) (s)	ug/L	P120	317	617	321	468	588	462
Iron, Dissolved (s)	ug/L		ND(19.8)	ND(19.8)	ND(19.8)	34.8	174	<53.7
Lead, Dissolved (e)	ug/L	P122	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	3.90	<3.24
Magnesium, Dissolved (s)	ug/L		818	572	514	419	1,030	671

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g., [N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Accommodations (SP-3) (a) Day 1	Accommodations (SP-3) (a) Day 2	Accommodations (SP-3) (a) Day 3	Accommodations (SP-3) (a) Day 4	Accommodations (SP-3) (a) Day 5	Average Accommodations (SP-3) (a)
Manganese, Dissolved (e) (s)	ug/L		11.1	5.00	5.60	6.00	7.10	6.96
Mercury, Dissolved (e) (s)	ug/L	P123	0.160	ND(0.0170)	0.0300	0.220	0.220	<0.129
Nickel, Dissolved (s)	ug/L	P124	13.5	10.1	10.6	12.2	17.3	12.7
Selenium, Dissolved	ug/L	P125	0.920	ND(0.572)	ND(0.572)	0.720	0.780	<0.713
Sodium, Dissolved (s)	ug/L		38,700	66,400	48,500	33,300	44,100	46,200
Thallium, Dissolved (e)	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Dissolved	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Dissolved	ug/L		ND(0.253)	ND(0.253)	ND(0.253)	ND(10.0)	ND(10.0)	ND(4.15)
Vanadium, Dissolved	ug/L		ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Dissolved (e) (s)	ug/L	P128	681	259	412	330	336	404
Volatile and Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	19.6	16.7	33.0	15.1	26.8	22.2
Chloroform	ug/L	P023	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	106	ND(14.0)	111	71.5	83.5	<77.2
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)

(a) Sampling point location; see Figure 2-1.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with two grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g., [N=2]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-4

Average Graywater Analytical Results, Island Princess

Average analytical results for galley, laundry, and accommodations wastewater from results presented in Tables 4-1 to 4-3. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are listed where applicable in the left-most column.

Analyte	Unit	Priority Pollutant Code	Galley Wastewater (SP-1) (a)	Laundry Wastewater (SP-2) (a)	Accommodations Wastewater (SP-3) (a)
Pathogen Indicators					
E. coli	MPN/100 mL		854,000	<22.5	<17,200
Enterococci	MPN/100 mL		> 13,900	# 486	# 966
Fecal Coliform	CFU/100 mL		104,000,000	<965	<175,000
Classical Pollutants					
Alkalinity	mg/L		<107	62.2	89.8
Ammonia As Nitrogen (NH3-N) (s)	mg/L		11.1	1.29	0.430
Biochemical Oxygen Demand (BOD_5)	mg/L		1,910	100	145
Chemical Oxygen Demand (COD)	mg/L		2,630	380	492
Chloride	mg/L		406	33.4	16.2
Hardness (s)	mg/L		145	25.2	25.1
Hexane Extractable Material (HEM)	mg/L		279	7.73	16.1
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		<0.0840	0.150	<0.0700
Settleable residue	mL/L		16.7	<1.73	<0.533
Silica Gel Treated HEM (SGT-HEM)	mg/L		ND(4.96)	ND(4.88)	ND(4.76)
Sulfate	mg/L		95.4	20.6	17.0
Total Dissolved Solids (TDS)	mg/L		1,720	256	217

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-4 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Wastewater (SP-1) (a)	Laundry Wastewater (SP-2) (a)	Accommodations Wastewater (SP-3) (a)
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		62.3	<8.90	6.82
Total Organic Carbon (TOC)	mg/L		499	78.7	53.0
Total Phosphorus	mg/L		23.8	8.30	0.766
Total Suspended Solids (TSS)	mg/L		979	62.2	83.2
Total and Dissolved Metals					
Aluminum, Total	ug/L		1,240	166	7,110
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)
Barium, Total (e)	ug/L		34.6	22.5	18.5
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	<0.0812
Boron, Total	ug/L		<157	ND(3.37)	<89.0
Cadmium, Total	ug/L	P118	<0.584	ND(0.446)	ND(0.446)
Calcium, Total (s)	ug/L		22,100	8,900	8,680
Chromium, Total	ug/L	P119	<7.28	5.02	<3.10
Cobalt, Total	ug/L		<0.931	<0.931	<0.931
Copper, Total (s)	ug/L	P120	620	325	580
Iron, Total	ug/L		703	230	179
Lead, Total (e)	ug/L	P122	<6.90	11.9	5.76
Magnesium, Total (s)	ug/L		21,800	710	823
Manganese, Total (e)	ug/L		41.2	3.96	6.52
Mercury, Total (e) (s)	ug/L	P123	<0.0822	0.0840	0.0960
Nickel, Total	ug/L	P124	27.0	7.86	12.4

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-4 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Wastewater (SP-1) (a)	Laundry Wastewater (SP-2) (a)	Accommodations Wastewater (SP-3) (a)
Selenium, Total (s)	ug/L	P125	15.2	<1.27	<0.673
Silver, Total	ug/L	P126	ND(1.28)	<4.10	ND(1.28)
Sodium, Total (s)	ug/L		309,000	48,300	48,400
Thallium, Total	ug/L	P127	<0.0114	ND(0.00900)	ND(0.00900)
Tin, Total	ug/L		25.7	ND(3.45)	ND(3.45)
Titanium, Total	ug/L		<3.45	<4.97	<4.95
Vanadium, Total	ug/L		ND(0.679)	ND(0.679)	<0.743
Zinc, Total (e) (s)	ug/L	P128	1,090	470	604
Aluminum, Dissolved	ug/L		583	<52.6	263
Barium, Dissolved (e)	ug/L		15.7	10.5	<0.342
Boron, Dissolved	ug/L		<86.1	ND(3.37)	ND(3.37)
Calcium, Dissolved (s)	ug/L		19,700	8,060	4,290
Chromium, Dissolved	ug/L	P119	<3.34	ND(1.68)	<2.17
Cobalt, Dissolved (s)	ug/L		4.84	2.68	<1.47
Copper, Dissolved (e) (s)	ug/L	P120	479	242	462
Iron, Dissolved (s)	ug/L		360	<33.3	<53.7
Lead, Dissolved (e)	ug/L	P122	<4.95	<5.60	<3.24
Magnesium, Dissolved (s)	ug/L		20,800	670	671
Manganese, Dissolved (e) (s)	ug/L		17.0	5.40	6.96
Mercury, Dissolved (e) (s)	ug/L	P123	0.0620	0.0780	<0.129
Nickel, Dissolved (s)	ug/L	P124	24.3	4.70	12.7

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-4 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Wastewater (SP-1) (a)	Laundry Wastewater (SP-2) (a)	Accommodations Wastewater (SP-3) (a)
Selenium, Dissolved	ug/L	P125	15.3	<0.698	<0.713
Sodium, Dissolved (s)	ug/L		294,000	47,900	46,200
Thallium, Dissolved (e)	ug/L	P127	<0.00960	ND(0.00900)	ND(0.00900)
Tin, Dissolved	ug/L		<15.0	ND(3.45)	ND(3.45)
Titanium, Dissolved	ug/L		<5.14	ND(4.15)	ND(4.15)
Vanadium, Dissolved	ug/L		<1.49	ND(0.679)	ND(0.679)
Zinc, Dissolved (e) (s)	ug/L	P128	956	339	404
Volatile and Semivolatile Organics					
Bis(2-ethylhexyl) Phthalate	ug/L	P066	<200	92.6	22.2
Chloroform	ug/L	P023	<10.7	101	ND(10.0)
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	97.5	93.2	<77.2
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)
Pesticides					
Simazine	ug/L		ND(8.00)	NC	NC

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).
- Average result includes at least one nondetect value (calculation uses detection limits for nondetected results) and at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-5

Comparison of Galley, Laundry, and Food Pulper Wastewater During Overboard Discharge, Island Princess

Average analytical results for galley and laundry wastewater during overboard discharge for analytes detected at least once during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are listed where applicable.

Analyte	Unit	Priority Pollutant Code	Galley Overboard Discharge (SP-8) (a)	Laundry Overboard Discharge (SP-9) (a)	Food Pulper Overboard (SP-10) (a)
Pathogen Indicators					
E. coli	MPN/100 mL		EXCLUDE	EXCLUDE	EXCLUDE
Enterococci	MPN/100 mL		EXCLUDE	EXCLUDE	EXCLUDE
Fecal Coliform	CFU/100 mL		EXCLUDE	EXCLUDE	EXCLUDE
Classical Pollutants					
Alkalinity	mg/L		90.0	90.0	ND(10.0)
Ammonia As Nitrogen (NH3-N) (s)	mg/L		2.72	2.32	35.0
Biochemical Oxygen Demand (BOD_5)	mg/L		976	85.4	2,160
Chemical Oxygen Demand (COD)	mg/L		1,270	234	2,150
Chloride	mg/L		83.0	142	973
Hardness (s)	mg/L		36.7	65.5	676
Hexane Extractable Material (HEM)	mg/L		150	19.5	194
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		ND(0.0500)	0.0600	ND(0.0500)
Settleable residue	mL/L		1.50	6.00	10.0
Silica Gel Treated HEM (SGT-HEM)	mg/L		ND(4.20)	ND(4.00)	ND(3.90)
Sulfate	mg/L		21.0	14.0	86.0
Total Dissolved Solids (TDS)	mg/L		666	394	2,720
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		21.8	7.50	98.7

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).

Table 4-5 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Overboard Discharge (SP-8) (a)	Laundry Overboard Discharge (SP-9) (a)	Food Pulper Overboard (SP-10) (a)
Total Organic Carbon (TOC)	mg/L		268	38.8	848
Total Phosphorus	mg/L		19.4	5.80	17.7
Total Suspended Solids (TSS)	mg/L		308	77.0	242
Total and Dissolved Metals					
Aluminum, Total	ug/L		735	321	404
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	6.00
Barium, Total (e)	ug/L		11.0	15.0	14.6
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	ND(0.0540)
Boron, Total	ug/L		ND(3.37)	ND(3.37)	526
Cadmium, Total	ug/L	P118	ND(0.446)	ND(0.446)	1.10
Calcium, Total (s)	ug/L		9,310	11,400	61,100
Chromium, Total	ug/L	P119	9.00	4.00	23.5
Cobalt, Total	ug/L		1.00	1.00	2.70
Copper, Total (s)	ug/L	P120	259	217	118
Iron, Total	ug/L		602	570	59,100
Lead, Total (e)	ug/L	P122	3.40	4.00	ND(3.08)
Magnesium, Total (s)	ug/L		3,270	8,990	127,000
Manganese, Total (e)	ug/L		17.0	8.00	260
Mercury, Total (e) (s)	ug/L	P123	0.110	ND(0.0170)	0.0900
Nickel, Total	ug/L	P124	14.0	10.0	19.7
Selenium, Total (s)	ug/L	P125	ND(0.572)	ND(0.572)	49.3
Silver, Total	ug/L	P126	ND(1.28)	3.00	ND(1.28)

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).

Table 4-5 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Overboard Discharge (SP-8) (a)	Laundry Overboard Discharge (SP-9) (a)	Food Pulper Overboard (SP-10) (a)
Sodium, Total (s)	ug/L		104,000	98,500	954,000
Thallium, Total	ug/L	P127	ND(0.00900)	ND(0.00900)	0.0100
Tin, Total	ug/L		10.0	ND(3.45)	7.00
Titanium, Total	ug/L		2.00	2.00	ND(0.253)
Vanadium, Total	ug/L		1.00	ND(0.679)	ND(0.679)
Zinc, Total (e) (s)	ug/L	P128	616	295	20,300
Aluminum, Dissolved	ug/L		456	71.8	86.1
Barium, Dissolved (e)	ug/L		6.10	11.1	15.2
Boron, Dissolved	ug/L		ND(3.37)	ND(3.37)	ND(3.37)
Calcium, Dissolved (s)	ug/L		8,330	8,940	66,900
Chromium, Dissolved	ug/L	P119	2.50	ND(1.68)	7.70
Cobalt, Dissolved (s)	ug/L		ND(0.914)	ND(0.914)	4.10
Copper, Dissolved (e) (s)	ug/L	P120	25.4	151	4.40
Iron, Dissolved (s)	ug/L		506	ND(19.8)	15,300
Lead, Dissolved (e)	ug/L	P122	ND(3.08)	ND(3.08)	ND(3.08)
Magnesium, Dissolved (s)	ug/L		2,680	4,550	30,300
Manganese, Dissolved (e) (s)	ug/L		23.0	5.50	114
Mercury, Dissolved (e) (s)	ug/L	P123	0.0200	ND(0.0170)	0.0700
Nickel, Dissolved (s)	ug/L	P124	11.9	5.50	27.0
Selenium, Dissolved	ug/L	P125	1.60	1.20	32.4
Sodium, Dissolved (s)	ug/L		103,000	77,600	240,000
Thallium, Dissolved (e)	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).

Table 4-5 (Continued)

Analyte	Unit	Priority Pollutant Code	Galley Overboard Discharge (SP-8) (a)	Laundry Overboard Discharge (SP-9) (a)	Food Pulper Overboard (SP-10) (a)
Tin, Dissolved	ug/L		5.80	ND(3.45)	5.10
Titanium, Dissolved	ug/L		ND(0.253)	ND(0.253)	ND(10.0)
Vanadium, Dissolved	ug/L		ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Dissolved (e) (s)	ug/L	P128	465	150	139,000
Volatile and Semivolatile Organics					
Bis(2-ethylhexyl) Phthalate	ug/L	P066	110	28.2	ND(10.0)
Bromomethane	ug/L	P046	ND(10.0)	ND(10.0)	
Chloroform	ug/L	P023	ND(10.0)	117	ND(10.0)
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	114	94.9	ND(10.0)
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)

(a) Sampling point location; see Figure 2-1.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).

Table 4-6

Influent to Treatment Analytical Results, Island Princess

Analytical results for the influent to treatment system for analytes detected at least once in wastewater samples during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Influent to treatment system samples were collected for five consecutive 24-hour periods; see Section 3.2 for the sample collection methodology. Figure 2-2 identifies the sampling point location. Average influent to treatment system concentrations determined from the daily results. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
Pathogen Indicators								
E. coli (b)	MPN/100 mL		>19,000,000 [N=3]	23,900,000 [N=3]	22,500,000 [N=3]	>87,600,000 [N=3]	29,800,000 [N=3]	>36,600,000
Enterococci (b)	MPN/100 mL		> 10,400,000 [N=3]	11,100,000 [N=3]	7,220,000 [N=3]	36,500,000 [N=3]	18,700,000 [N=3]	>16,800,000
Fecal Coliform (b)	CFU/100 mL		23,400,000 [N=3]	503,000,000 [N=3]	341,000,000 [N=3]	61,600,000 [N=3]	21,400,000 [N=3]	190,000,000
Classical Pollutants								
Alkalinity	mg/L		580	354	376	293	377	396
Ammonia As Nitrogen (NH3-N) (s)	mg/L		139	69.6	84.6	97.6	80.2	94.2
Biochemical Oxygen Demand (BOD_5)	mg/L		338	224	409	329	EXCLUDE	325
Chemical Oxygen Demand (COD)	mg/L		1,560	1,430	667	546	577	956
Chloride	mg/L		1,530	852	1,180	602	527	938
Hardness (s)	mg/L		573	346	563	269	258	402
Hexane Extractable Material (HEM)	mg/L		131	59.2	70.9	117	269	129
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		0.0600	0.100	ND(0.0500)	ND(0.0500)	ND(0.0500)	<0.0620
Settleable residue	mL/L		1.10	2.60	93.0	65.0	EXCLUDE	40.4

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
Silica Gel Treated HEM (SGT-HEM)	mg/L		72.0	17.0	42.7	55.7	124	62.3
Sulfate	mg/L		204	127	138	93.0	107	134
Total Dissolved Solids (TDS)	mg/L		2,880	1,660	2,370	1,300	1,030	1,850
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		354	120	194	110	125	181
Total Organic Carbon (TOC)	mg/L		250	172	104	79.4	96.9	140
Total Phosphorus	mg/L		71.6	18.2	18.2	16.8	16.6	28.3
Total Suspended Solids (TSS)	mg/L		1,560	1,470	907	960	860	1,150
Total and Dissolved Metals								
Aluminum, Total	ug/L		6,850	8,180	4,670	3,330	3,330	5,270
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)
Barium, Total (e)	ug/L		76.0	74.0	44.0	29.0	42.7	53.1
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)
Boron, Total	ug/L		467	287	496	292	322	373
Cadmium, Total	ug/L	P118	1.00	1.00	2.00	0.650	ND(0.446)	<1.02
Calcium, Total (s)	ug/L		56,200	39,900	57,100	32,200	35,300	44,100
Chromium, Total	ug/L	P119	10.0	14.0	12.0	8.70	7.30	10.4
Cobalt, Total	ug/L		ND(0.914)	ND(0.914)	ND(0.914)	ND(0.914)	ND(0.914)	ND(0.914)
Copper, Total (s)	ug/L	P120	1,330	1,580	924	755	1,280	1,170
Iron, Total	ug/L		1,450	1,670	1,060	694	945	1,160
Lead, Total (e)	ug/L	P122	21.0	21.0	26.0	14.2	14.8	19.4

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
Magnesium, Total (s)	ug/L		105,000	59,800	102,000	45,800	41,200	70,800
Manganese, Total (e)	ug/L		108	81.0	88.0	56.4	67.4	80.2
Mercury, Total (e) (s)	ug/L	P123	1.00	0.360	0.290	0.280	0.280	0.442
Nickel, Total	ug/L	P124	26.0	23.0	46.0	20.9	22.3	27.6
Selenium, Total (s)	ug/L	P125	50.0	33.0	44.0	26.0	18.4	34.3
Silver, Total	ug/L	P126	3.00	2.00	3.00	ND(1.28)	ND(1.28)	<2.11
Sodium, Total (s)	ug/L		792,000	446,000	612,000	331,000	281,000	492,000
Thallium, Total	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	0.0100	0.0100	<0.00940
Tin, Total	ug/L		7.00	10.0	15.0	12.9	31.7	15.3
Titanium, Total	ug/L		ND(0.253)	4.00	3.00	2.40	3.30	<2.59
Vanadium, Total	ug/L		15.0	11.0	21.0	6.10	5.10	11.6
Zinc, Total (e) (s)	ug/L	P128	2,350	1,880	1,090	902	950	1,430
Aluminum, Dissolved	ug/L		129	119	106	96.5	130	116
Barium, Dissolved (e)	ug/L		6.00	3.60	4.40	2.80	5.60	4.48
Boron, Dissolved	ug/L		442	289	369	ND(3.37)	ND(3.37)	<221
Calcium, Dissolved (s)	ug/L		37,800	24,400	33,400	20,300	20,200	27,200
Chromium, Dissolved	ug/L	P119	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)
Cobalt, Dissolved (s)	ug/L		7.90	ND(0.914)	8.50	8.60	7.00	<6.58
Copper, Dissolved (e) (s)	ug/L	P120	25.2	39.5	31.7	47.3	79.8	44.7
Iron, Dissolved (s)	ug/L		ND(19.8)	ND(19.8)	ND(19.8)	269	115	<88.7

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
Lead, Dissolved (e)	ug/L	P122	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)
Magnesium, Dissolved (s)	ug/L		91,500	51,900	71,600	37,000	29,700	56,300
Manganese, Dissolved (e) (s)	ug/L		25.9	13.1	28.6	23.2	19.3	22.0
Mercury, Dissolved (e) (s)	ug/L	P123	ND(0.0170)	ND(0.0170)	0.0300	0.0700	0.0500	<0.0368
Nickel, Dissolved (s)	ug/L	P124	11.3	11.4	22.8	20.0	13.1	15.7
Selenium, Dissolved	ug/L	P125	42.9	25.7	32.8	24.8	22.6	29.8
Sodium, Dissolved (s)	ug/L		821,000	451,000	471,000	310,000	269,000	464,000
Thallium, Dissolved (e)	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Dissolved	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Dissolved	ug/L		ND(0.253)	ND(0.253)	ND(0.253)	ND(10.0)	ND(10.0)	ND(4.15)
Vanadium, Dissolved	ug/L		ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)	ND(0.679)
Zinc, Dissolved (e) (s)	ug/L	P128	83.4	119	91.6	104	102	100
Volatile and Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	29.0	23.7	58.1	26.6	22.2	31.9
Chloroform	ug/L	P023	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	10.5	ND(10.0)	ND(10.0)	<10.1
Phenol (s)	ug/L	P065	244	127	140	111	122	149
Tetrachloroethene	ug/L	P085	28.7	29.2	ND(10.0)	11.3	ND(10.0)	<17.8
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	10.7	ND(10.0)	ND(10.0)	<10.1

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
Pesticides								
Simazine	ug/L		NC	NC	0.960	NC	NC	
Polychlorinated Biphenyls								
PCB-2	pg/L		42.5	NC	NC	NC	NC	
PCB-6	pg/L		156	NC	NC	NC	NC	
PCB-8	pg/L		807	NC	NC	NC	NC	
PCB-11	pg/L		1,240	NC	NC	NC	NC	
PCB-16	pg/L		905	NC	NC	NC	NC	
PCB-17	pg/L		849	NC	NC	NC	NC	
PCB-18+PCB-30	pg/L		1,750	NC	NC	NC	NC	
PCB-19	pg/L		176	NC	NC	NC	NC	
PCB-20+PCB-28	pg/L		2,680	NC	NC	NC	NC	
PCB-21+PCB-33	pg/L		1,640	NC	NC	NC	NC	
PCB-22	pg/L		1,060	NC	NC	NC	NC	
PCB-26+PCB-29	pg/L		474	NC	NC	NC	NC	
PCB-31	pg/L		2,410	NC	NC	NC	NC	
PCB-32	pg/L		505	NC	NC	NC	NC	
PCB-35	pg/L		235	NC	NC	NC	NC	
PCB-37	pg/L		773	NC	NC	NC	NC	
PCB-40+PCB-41+PCB-71	pg/L		1,170	NC	NC	NC	NC	

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
PCB-42	pg/L		537	NC	NC	NC	NC	
PCB-44+PCB-47+PCB-65	pg/L		2,820	NC	NC	NC	NC	
PCB-45+PCB-51	pg/L		551	NC	NC	NC	NC	
PCB-48	pg/L		473	NC	NC	NC	NC	
PCB-49+PCB-69	pg/L		1,020	NC	NC	NC	NC	
PCB-50+PCB-53	pg/L		250	NC	NC	NC	NC	
PCB-52	pg/L		1,610	NC	NC	NC	NC	
PCB-56	pg/L		810	NC	NC	NC	NC	
PCB-61+PCB-70+PCB-74+PCB-76	pg/L		2,990	NC	NC	NC	NC	
PCB-64	pg/L		786	NC	NC	NC	NC	
PCB-66	pg/L		1,460	NC	NC	NC	NC	
PCB-83+PCB-99	pg/L		768	NC	NC	NC	NC	
PCB-86+PCB-87+PCB-97+PCB-108+P	pg/L		660	NC	NC	NC	NC	
PCB-93+PCB-95+PCB-98+PCB-100+P	pg/L		713	NC	NC	NC	NC	
PCB-105	pg/L		406	NC	NC	NC	NC	
PCB-118	pg/L		984	NC	NC	NC	NC	
PCB-129+PCB-138+PCB-160+PCB-163	pg/L		1,650	NC	NC	NC	NC	
PCB-153+PCB-168	pg/L		1,740	NC	NC	NC	NC	

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-6 (Continued)

Analyte	Unit	Priority Pollutant Code	Influent to Treatment (SP-4) (a) Day 1	Influent to Treatment (SP-4) (a) Day 2	Influent to Treatment (SP-4) (a) Day 3	Influent to Treatment (SP-4) (a) Day 4	Influent to Treatment (SP-4) (a) Day 5	Average Influent to Treatment (SP-4) (a)
PCB-180+PCB-193	pg/L		986	NC	NC	NC	NC	
Total Dichloro Biphenyls	pg/L		2,200	NC	NC	NC	NC	
Total Hexachloro Biphenyls	pg/L		3,390	NC	NC	NC	NC	
Total PCBs	pg/L		37,100	NC	NC	NC	NC	
Total Pentachloro Biphenyls	pg/L		3,530	NC	NC	NC	NC	
Total Tetrachloro Biphenyls	pg/L		14,500	NC	NC	NC	NC	
Total Trichloro Biphenyls	pg/L		13,500	NC	NC	NC	NC	

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period (some fecal coliform results were excluded; see Section 5.1). Results are reported as an average for each 24-hour period, followed by an indication of the number of results include din the average (e.g.,[N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not collected.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-7

Influent to UV Disinfection Analytical Results, Island Princess

Analytical results for the influent to UV disinfection part of the wastewater treatment system. Influent to UV disinfection samples were collected for five consecutive 24-hour sampling periods; see Section 3.2 for the sample collection methodology. Figure 2-2 identifies sampling point location. Average influent to UV concentrations determined from the daily results.

Analyte	Unit	Influent to UV Disinfection (SP-5) (a) Day 1	Influent to UV Disinfection (SP-5) (a) Day 2	Influent to UV Disinfection (SP-5) (a) Day 3	Influent to UV Disinfection (SP-5) (a) Day 4	Influent to UV Disinfection (SP-5) (a) Day 5	Average Influent to UV Disinfection (SP-5) (a)
Pathogen Indicators							
E. coli (b)	MPN/100 mL	< 1.00 [N=3]	ND(1.00) [N=3]	ND(1.00) [N=3]	ND(1.00) [N=3]	< 1.00 [N=3]	<1.00
Enterococci (b)	MPN/100 mL	< 1.00 [N=3]	< 1.00 [N=3]	ND(1.00) [N=3]	ND(1.00) [N=3]	< 10.0 [N=3]	<2.80
Fecal Coliform (b)	CFU/100 mL	ND(4.67) [N=3]	ND(2.00) [N=3]	ND(2.00) [N=3]	ND(2.00) [N=3]	< 2.00 [N=3]	<2.53

(a) Sampling point location; see Figure 2-2.
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples collected per 24-hour sampling period. Results are reported as an average for each 24-hour period, followed by an indication of the number of results included in the average (e.g., [N=3]). See Appendix A-1 for all individual grab sample results.
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 4-8

Effluent from Treatment Analytical Results, Island Princess

Analytical results for the effluent from treatment system for analytes detected at least once in wastewater samples during the sampling episode. See Appendices A-1 and A-2 for all analytical results (detected and nondetected). Effluent from treatment system samples were collected for five consecutive 24-hour periods; see Section 3.2 for the sample collection methodology. Figure 2-2 identifies the sampling point location. Average effluent from treatment concentrations determined from the daily results. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Effluent from Treatment (SP-6) (a) Day 1	Effluent from Treatment (SP-6) (a) Day 2	Effluent from Treatment (SP-6) (a) Day 3	Effluent from Treatment (SP-6) (a) Day 4	Effluent from Treatment (SP-6) (a) Day 5	Average Effluent from Treatment (SP-6) (a)
Pathogen Indicators								
E. coli (b)	MPN/100 mL		< 1.70 [N=3]	ND(1.00) [N=3]	ND(1.00) [N=3]	<1.00 [N=3]	ND(1.00) [N=3]	<1.14
Enterococci (b)	MPN/100 mL		< 1.00 [N=3]	ND(1.00) [N=3]	ND(1.00) [N=3]	< 1.70 [N=3]	< 1.33 [N=3]	<1.21
Fecal Coliform (b)	CFU/100 mL		< 8.00 [N=3]	ND(2.00) [N=3]	ND(2.00) [N=3]	ND(2.00) [N=3]	ND(2.00) [N=3]	<3.20
Classical Pollutants								
Alkalinity	mg/L		150	219	215	191	204	196
Ammonia As Nitrogen (NH3-N) (s)	mg/L		27.9	41.1	47.3	38.1	42.6	39.4
Biochemical Oxygen Demand (BOD_5)	mg/L		ND(2.00)	ND(2.00)	7.85	ND(2.00)	EXCLUDE	<3.46
Chemical Oxygen Demand (COD)	mg/L		56.0	61.0	73.5	64.5	67.0	64.4
Chloride	mg/L		915	1,210	1,320	952	792	1,040
Hardness (s)	mg/L		310	359	437	329	274	342
Hexane Extractable Material (HEM)	mg/L		ND(5.10)	ND(5.10)	ND(4.80)	ND(5.00)	ND(4.80)	ND(4.96)
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		0.0500	0.230	ND(0.0500)	ND(0.0500)	ND(0.0500)	<0.0860
Settleable residue	mL/L		ND(0.100)	ND(0.100)	ND(0.100)	ND(0.100)	EXCLUDE	ND(0.100)
Silica Gel Treated HEM (SGT-HEM)	mg/L		ND(5.10)	ND(5.10)	ND(4.80)	ND(5.00)	ND(4.80)	ND(4.96)
Sulfate	mg/L		124	166	180	129	110	142
Total Dissolved Solids (TDS)	mg/L		1,750	2,300	2,600	1,690	1,580	1,980

(a) Sampling point location; see Figure 2-2
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples per 24-hour sampling period. Results are reported as an average for each 24-hour sampling period, followed by an indication of the number of results included in the average (e.g., [N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value.

Table 4-8 (Continued)

Analyte	Unit	Priority Pollutant Code	Effluent from Treatment (SP-6) (a) Day 1	Effluent from Treatment (SP-6) (a) Day 2	Effluent from Treatment (SP-6) (a) Day 3	Effluent from Treatment (SP-6) (a) Day 4	Effluent from Treatment (SP-6) (a) Day 5	Average Effluent from Treatment (SP-6) (a)
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		27.6	45.0	53.2	43.8	46.4	43.2
Total Organic Carbon (TOC)	mg/L		17.2	13.9	16.5	14.7	15.2	15.5
Total Phosphorus	mg/L		6.20	6.30	8.10	7.45	8.25	7.26
Total Suspended Solids (TSS)	mg/L		ND(5.00)	ND(5.00)	ND(5.00)	ND(5.00)	< 18.5	<7.70
Total and Dissolved Metals								
Aluminum, Total	ug/L		< 19.0	48.5	38.0	ND(9.93)	ND(9.93)	<25.1
Antimony, Total	ug/L	P114	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)	ND(5.97)
Barium, Total (e)	ug/L		6.00	6.00	6.00	4.40	4.40	5.36
Beryllium, Total (e)	ug/L	P117	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)	ND(0.0540)
Boron, Total	ug/L		317	346	400	347	333	348
Cadmium, Total	ug/L	P118	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)	ND(0.446)
Calcium, Total (s)	ug/L		28,800	31,900	39,500	31,300	28,800	32,000
Chromium, Total	ug/L	P119	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)
Cobalt, Total	ug/L		ND(0.914)	< 0.957	ND(0.914)	ND(0.914)	ND(0.914)	<0.923
Copper, Total (s)	ug/L	P120	15.2	18.5	15.0	15.3	27.7	18.3
Iron, Total	ug/L		165	175	176	208	156	176
Lead, Total (e)	ug/L	P122	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)
Magnesium, Total (s)	ug/L		57,900	67,800	82,100	60,800	49,100	63,500
Manganese, Total (e)	ug/L		19.2	19.0	23.0	18.5	17.2	19.4
Mercury, Total (e) (s)	ug/L	P123	0.0250	0.0550	0.0200	0.0300	0.0400	0.0340
Nickel, Total	ug/L	P124	12.6	11.5	20.0	15.6	11.9	14.3
Selenium, Total (s)	ug/L	P125	20.9	27.5	42.0	32.2	28.3	30.2

(a) Sampling point location; see Figure 2-2
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples per 24-hour sampling period. Results are reported as an average for each 24-hour sampling period, followed by an indication of the number of results included in the average (e.g., [N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value.

Table 4-8 (Continued)

Analyte	Unit	Priority Pollutant Code	Effluent from Treatment (SP-6) (a) Day 1	Effluent from Treatment (SP-6) (a) Day 2	Effluent from Treatment (SP-6) (a) Day 3	Effluent from Treatment (SP-6) (a) Day 4	Effluent from Treatment (SP-6) (a) Day 5	Average Effluent from Treatment (SP-6) (a)
Silver, Total	ug/L	P126	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)	ND(1.28)
Sodium, Total (s)	ug/L		500,000	583,000	664,000	505,000	413,000	533,000
Thallium, Total	ug/L	P127	< 0.00950	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	<0.00910
Tin, Total	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Total	ug/L		ND(0.253)	ND(0.253)	ND(0.253)	ND(0.253)	ND(0.253)	ND(0.253)
Vanadium, Total	ug/L		< 0.890	ND(0.679)	ND(0.679)	< 0.755	1.50	<0.900
Zinc, Total (e) (s)	ug/L	P128	222	214	152	226	219	207
Aluminum, Dissolved	ug/L		< 28.2	ND(9.93)	ND(9.93)	49.9	53.7	<30.3
Barium, Dissolved (e)	ug/L		6.05	6.50	5.80	4.55	4.50	5.48
Boron, Dissolved	ug/L		315	366	388	< 169	324	<312
Calcium, Dissolved (s)	ug/L		28,800	33,800	37,900	31,100	29,300	32,200
Chromium, Dissolved	ug/L	P119	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)	ND(1.68)
Cobalt, Dissolved (s)	ug/L		< 1.06	ND(0.914)	ND(0.914)	< 1.46	2.60	<1.39
Copper, Dissolved (e) (s)	ug/L	P120	13.9	17.4	13.1	14.4	25.7	16.9
Iron, Dissolved (s)	ug/L		< 91.4	ND(19.8)	ND(19.8)	158	140	<85.8
Lead, Dissolved (e)	ug/L	P122	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)	ND(3.08)
Magnesium, Dissolved (s)	ug/L		57,500	73,200	78,000	60,700	50,200	63,900
Manganese, Dissolved (e) (s)	ug/L		21.1	23.8	23.1	19.4	21.5	21.8
Mercury, Dissolved (s)	ug/L	P123	< 0.0285	ND(0.0170)	ND(0.0170)	< 0.0235	0.0400	<0.0252
Nickel, Dissolved (s)	ug/L	P124	12.8	11.4	19.3	14.1	12.9	14.0
Selenium, Dissolved	ug/L	P125	32.0	43.6	72.1	29.8	28.4	41.2
Sodium, Dissolved (s)	ug/L		546,000	990,000	674,000	480,000	406,000	619,000

(a) Sampling point location; see Figure 2-2
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples per 24-hour sampling period. Results are reported as an average for each 24-hour sampling period, followed by an indication of the number of results included in the average (e.g., [N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value.

Table 4-8 (Continued)

Analyte	Unit	Priority Pollutant Code	Effluent from Treatment (SP-6) (a) Day 1	Effluent from Treatment (SP-6) (a) Day 2	Effluent from Treatment (SP-6) (a) Day 3	Effluent from Treatment (SP-6) (a) Day 4	Effluent from Treatment (SP-6) (a) Day 5	Average Effluent from Treatment (SP-6) (a)
Thallium, Dissolved (e)	ug/L	P127	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)	ND(0.00900)
Tin, Dissolved	ug/L		ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)	ND(3.45)
Titanium, Dissolved	ug/L		ND(5.13)	ND(0.253)	ND(0.253)	ND(10.0)	ND(10.0)	ND(5.13)
Vanadium, Dissolved	ug/L		< 1.09	ND(0.679)	< 0.890	< 0.695	1.90	<1.05
Zinc, Dissolved (e) (s)	ug/L	P128	223	209	151	222	219	205
Volatile and Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	ND(10.0)	< 13.4	< 14.5	ND(10.0)	ND(10.0)	<11.6
Chloroform	ug/L	P023	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Methylene Chloride	ug/L	P044	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Phenol (s)	ug/L	P065	85.8	68.2	109	79.5	64.9	81.4
Tetrachloroethene	ug/L	P085	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)
Toluene	ug/L	P086	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)	ND(10.0)

(a) Sampling point location; see Figure 2-2
(b) Samples for pathogen indicator analyses were collected as grab samples for individual analysis, with three grab samples per 24-hour sampling period. Results are reported as an average for each 24-hour sampling period, followed by an indication of the number of results included in the average (e.g., [N=3]). See Appendix A-1 for all individual grab sample results.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetect value.

Table 4-9

Wastewater Treatment System: Performance Data for Pathogen Indicators, Island Princess

Pathogen indicators performance data for the Island's Hamworthy wastewater treatment system. Average analyte concentrations were determined from the daily results presented in Tables 4-6 through 4-8. Percent removals were calculated using the average influent to and effluent from treatment analyte concentrations.

Analyte	Unit	Average Influent to Treatment Concentration (SP-4) (a)	Average Influent to UV Disinfection Concentration (SP-5) (a)	Average Effluent from Treatment Concentration (SP-6) (a)	Percent Removal
Pathogen Indicators					
E. coli	MPN/100 mL	>36,600,000	<1.00	<1.14	> 99
Enterococci	MPN/100 mL	>16,800,000	<2.80	<1.21	> 99
Fecal Coliform	CFU/100 mL	190,000,000	<2.54	<3.20	> 99

(a) Sampling point location; see Figure 2-2.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Average result includes at least one result flagged by the laboratory as ">" because the sample was not diluted sufficiently (see Appendix D).

Table 4-10

Wastewater Treatment System: Performance Data for Analytes Other Than Pathogen Indicators, Island Princess

Performance data for the Island's Hamworthy wastewater treatment system for analytes other than pathogen indicators detected in either the influent to or effluent from treatment. Range and average analyte concentrations were determined from the daily results presented in Tables 4-6 and 4-8. Percent removals were calculated using the average influent to and effluent from treatment analyte concentrations. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Average Influent to Treatment Concentration (SP-4) (a)	Influent to Treatment Concentration Range (SP-4) (a)	Average Effluent from Treatment Concentration (SP-6) (a)	Effluent from Treatment Concentration Range (SP-6) (a)	Percent Removal
Classical Pollutants							
Alkalinity	mg/L		396	293 - 580	196	150 - 219	51
Ammonia As Nitrogen (NH3-N) (s)	mg/L		94.2	69.6 - 139	39.4	27.9 - 47.3	58
Biochemical Oxygen Demand (BOD_5)	mg/L		325	224 - 409	<3.46	ND(2.00) - 7.85	99
Chemical Oxygen Demand (COD)	mg/L		956	546 - 1,560	64.4	56.0 - 73.5	93
Chloride	mg/L		938	527 - 1,530	1,040	792 - 1,320	NC
Hardness (s)	mg/L		402	258 - 573	342	274 - 437	15
Hexane Extractable Material (HEM)	mg/L		129	59.2 - 269	ND(4.96)	ND(4.80) - ND(5.10)	> 96
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		<0.0620	ND(0.0500) - 0.100	<0.0860	ND(0.0500) - 0.230	NC
Settleable residue	mL/L		40.4	1.10 - 93.0	ND(0.100)	ND(0.100)	> 99
Silica Gel Treated HEM (SGT-HEM)	mg/L		62.3	17.0 - 124	ND(4.96)	ND(4.80) - ND(5.10)	> 92
Sulfate	mg/L		134	93.0 - 204	142	110 - 180	NC
Total Dissolved Solids (TDS)	mg/L		1,850	1,030 - 2,880	1,980	1,580 - 2,600	NC
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		181	110 - 354	43.2	27.6 - 53.2	76
Total Organic Carbon (TOC)	mg/L		140	79.4 - 250	15.5	13.9 - 17.2	89
Total Phosphorus	mg/L		28.3	16.6 - 71.6	7.26	6.20 - 8.25	74

(a) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
ND - Not detected (number in parentheses is detection limit).
NC - Percent removal not calculated because the effluent concentration was greater than the influent concentration or the analyte was not detected in the influent sample.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Indicates a minimum level of removal.

Table 4-10 (Continued)

Analyte	Unit	Priority Pollutant Code	Average Influent to Treatment Concentration (SP-4) (a)	Influent to Treatment Concentration Range (SP-4) (a)	Average Effluent from Treatment Concentration (SP-6) (a)	Effluent from Treatment Concentration Range (SP-6) (a)	Percent Removal
Total Suspended Solids (TSS)	mg/L		1,150	860 - 1,560	<7.70	ND(5.00) - <18.5	99
Total and Dissolved Metals							
Aluminum, Total	ug/L		5,270	3,330 - 8,180	<25.1	ND(9.93) - 48.5	> 99
Barium, Total (e)	ug/L		53.1	29.0 - 76.0	5.36	4.40 - 6.00	90
Boron, Total	ug/L		373	287 - 496	348	317 - 400	6.6
Cadmium, Total	ug/L	P118	<1.02	ND(0.446) - 2.00	ND(0.446)	ND(0.446)	> 56
Calcium, Total (s)	ug/L		44,100	32,200 - 57,100	32,000	28,800 - 39,500	27
Chromium, Total	ug/L	P119	10.4	7.30 - 14.0	ND(1.68)	ND(1.68)	> 84
Cobalt, Total	ug/L		ND(0.914)	ND(0.914)	<0.923	ND(0.914) - <0.957	NC
Copper, Total (s)	ug/L	P120	1,170	755 - 1,580	18.3	15.0 - 27.7	98
Iron, Total	ug/L		1,160	694 - 1,670	176	156 - 208	85
Lead, Total (e)	ug/L	P122	19.4	14.2 - 26.0	ND(3.08)	ND(3.08)	> 84
Magnesium, Total (s)	ug/L		70,800	41,200 - 105,000	63,500	49,100 - 82,100	10
Manganese, Total (e)	ug/L		80.2	56.4 - 108	19.4	17.2 - 23.0	76
Mercury, Total (e) (s)	ug/L	P123	0.442	0.280 - 1.00	0.0340	0.0200 - 0.0550	92
Nickel, Total	ug/L	P124	27.6	20.9 - 46.0	14.3	11.5 - 20.0	48
Selenium, Total (s)	ug/L	P125	34.3	18.4 - 50.0	30.2	20.9 - 42.0	12
Silver, Total	ug/L	P126	<2.11	ND(1.28) - 3.00	ND(1.28)	ND(1.28)	> 40
Sodium, Total (s)	ug/L		492,000	281,000 - 792,000	533,000	413,000 - 664,000	NC
Thallium, Total	ug/L	P127	<0.00940	ND(0.00900) - 0.0100	<0.00910	ND(0.00900) - <0.00950	3.2
Tin, Total	ug/L		15.3	7.00 - 31.7	ND(3.45)	ND(3.45)	> 77

(a) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
ND - Not detected (number in parentheses is detection limit).
NC - Percent removal not calculated because the effluent concentration was greater than the influent concentration or the analyte was not detected in the influent sample.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Indicates a minimum level of removal.

Table 4-10 (Continued)

Analyte	Unit	Priority Pollutant Code	Average Influent to Treatment Concentration (SP-4) (a)	Influent to Treatment Concentration Range (SP-4) (a)	Average Effluent from Treatment Concentration (SP-6) (a)	Effluent from Treatment Concentration Range (SP-6) (a)	Percent Removal
Titanium, Total	ug/L		<2.59	ND(0.253) - 4.00	ND(0.253)	ND(0.253)	> 90
Vanadium, Total	ug/L		11.6	5.10 - 21.0	<0.900	ND(0.679) - 1.50	92
Zinc, Total (e) (s)	ug/L	P128	1,430	902 - 2,350	207	152 - 226	86
Aluminum, Dissolved	ug/L		116	96.5 - 130	<30.3	ND(9.93) - 53.7	74
Barium, Dissolved (e)	ug/L		4.48	2.80 - 6.00	5.48	4.50 - 6.50	NC
Boron, Dissolved	ug/L		<221	ND(3.37) - 442	<312	<169 - 388	NC
Calcium, Dissolved (s)	ug/L		27,200	20,200 - 37,800	32,200	28,800 - 37,900	NC
Cobalt, Dissolved (s)	ug/L		<6.58	ND(0.914) - 8.60	<1.39	ND(0.914) - 2.60	79
Copper, Dissolved (e) (s)	ug/L	P120	44.7	25.2 - 79.8	16.9	13.1 - 25.7	62
Iron, Dissolved (s)	ug/L		<88.7	ND(19.8) - 269	<85.8	ND(19.8) - 158	3.3
Magnesium, Dissolved (s)	ug/L		56,300	29,700 - 91,500	63,900	50,200 - 78,000	NC
Manganese, Dissolved (e) (s)	ug/L		22.0	13.1 - 28.6	21.8	19.4 - 23.8	1.2
Mercury, Dissolved (e) (s)	ug/L	P123	<0.0368	ND(0.0170) - 0.0700	<0.0252	ND(0.0170) - 0.0400	32
Nickel, Dissolved (s)	ug/L	P124	15.7	11.3 - 22.8	14.1	11.4 - 19.3	10
Selenium, Dissolved	ug/L	P125	29.8	22.6 - 42.9	41.2	28.4 - 72.1	NC
Sodium, Dissolved (s)	ug/L		464,000	269,000 - 821,000	619,000	406,000 - 990,000	NC
Vanadium, Dissolved	ug/L		ND(0.679)	ND(0.679)	<1.05	ND(0.679) - 1.90	NC
Zinc, Dissolved (e) (s)	ug/L	P128	100	83.4 - 119	205	151 - 223	NC

(a) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
ND - Not detected (number in parentheses is detection limit).
NC - Percent removal not calculated because the effluent concentration was greater than the influent concentration or the analyte was not detected in the influent sample.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Indicates a minimum level of removal.

Table 4-10 (Continued)

Analyte	Unit	Priority Pollutant Code	Average Influent to Treatment Concentration (SP-4) (a)	Influent to Treatment Concentration Range (SP-4) (a)	Average Effluent from Treatment Concentration (SP-6) (a)	Effluent from Treatment Concentration Range (SP-6) (a)	Percent Removal
Volatile and Semivolatile Organics							
Bis(2-ethylhexyl) Phthalate	ug/L	P066	31.9	22.2 - 58.1	<11.6	ND(10.0) - <14.5	64
Methylene Chloride	ug/L	P044	<10.1	ND(10.0) - 10.5	ND(10.0)	ND(10.0)	> 0.99
Phenol (s)	ug/L	P065	149	111 - 244	81.4	64.9 - 109	45
Tetrachloroethene	ug/L	P085	<17.8	ND(10.0) - 29.2	ND(10.0)	ND(10.0)	> 44
Toluene	ug/L	P086	<10.1	ND(10.0) - 10.7	ND(10.0)	ND(10.0)	> 1.4

(a) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
ND - Not detected (number in parentheses is detection limit).
NC - Percent removal not calculated because the effluent concentration was greater than the influent concentration or the analyte was not detected in the influent sample.
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).
> - Indicates a minimum level of removal.

Table 4-11

Treatment System Residual and Incinerator Ash Analytical Results, Island Princess

Analytical results for one-time grab samples of treatment system residual (i.e., screening solids and excess biological mass from bioreactors) and incinerator ash for analytes detected at least once in these samples. See Appendix A-2 for all analytical results (detected and nondetected). Figure 2-2 identifies the sampling point locations; see Table 3-2 for sample collection methodology. Also shown are average concentrations for the influent to treatment samples (from Table 4-6) for comparison. Certain screening solids results were converted from mass to volume units; see Section 3.3. Priority pollutants (designated by EPA in 40 CRF Part 423, Appendix A) are identified where applicable.

Analyte	Priority Pollutant Code	Screening Solids (SP-11) (a) Day 3	Biosludge (SP-12) (a) Day 1	Incinerator Ash (SP-13) (a) Day 3	Average Influent to Treatment (SP-4) (a)
Classical Pollutants					
Alkalinity		892 mg/L	810 mg/L	NC	396 mg/L
Ammonia As Nitrogen (NH3-N) (s)		318 mg/L	40.1 mg/L	NC	94.2 mg/L
Chemical Oxygen Demand (COD)		124,000 mg/L	14,400 mg/L	NC	956 mg/L
Chloride		933 mg/L	1,120 mg/L	NC	938 mg/L
Hardness (s)		NC	1,640 mg/L	NC	402 mg/L
Nitrate/Nitrite (NO2-N+ NO3-N)		1.35 mg/L	0.240 mg/L	NC	<0.0620 mg/L
Sulfate		1,320 mg/L	163 mg/L	NC	134 mg/L
Total Dissolved Solids (TDS)		NC	1,280 mg/L	NC	1,850 mg/L
Total Kjeldahl Nitrogen (TKN) (s)		1,740 mg/L	561 mg/L	NC	181 mg/L
Total Organic Carbon (TOC)		151,000 mg/L	2,730 mg/L	NC	140 mg/L
Total Phosphorus		930 mg/L	173 mg/L	NC	28.3 mg/L
Total Suspended Solids (TSS)		NC	15,800 mg/L	NC	1,150 mg/L
Total Metals					
Aluminum, Total		266,000 ug/L	120,000 ug/L	67,100 mg/kg	5,270 ug/L
Antimony, Total	P114	ND(201) ug/L	74.0 ug/L	7.50 mg/kg	ND(5.97) ug/L
Arsenic, Total	P115	ND(198) ug/L	12.0 ug/L	1.40 mg/kg	ND(2.32) ug/L
Barium, Total		3,730 ug/L	1,790 ug/L	381 mg/kg	53.1 ug/L
Beryllium, Total	P117	ND(11.7) ug/L	1.00 ug/L	0.510 mg/kg	ND(0.00540) ug/L

(a) Sampling point location; see Figure 2-2.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
NC - Not collected.
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetected value (calculation uses detection limits for nondetected results).

Table 4-11 (Continued)

Analyte	Priority Pollutant Code	Screening Solids (SP-11) (a) Day 3	Biosludge (SP-12) (a) Day 1	Incinerator Ash (SP-13) (a) Day 3	Average Influent to Treatment (SP-4) (a)
Boron, Total		ND(457) ug/L	858 ug/L	107 mg/kg	373 ug/L
Cadmium, Total	P118	88.5 ug/L	25.0 ug/L	0.500 mg/kg	<1.02 ug/L
Calcium, Total (s)		1,750,000 ug/L	316,000 ug/L	257,000 mg/kg	44,100 ug/L
Chromium, Total	P119	1,490 ug/L	282 ug/L	87.1 mg/kg	10.4 ug/L
Cobalt, Total		ND(23.3) ug/L	26.0 ug/L	8.90 mg/kg	ND(0.914) ug/L
Copper, Total (s)	P120	64,800 ug/L	21,400 ug/L	1,290 mg/kg	1,170 ug/L
Iron, Total		123,000 ug/L	20,500 ug/L	11,500 mg/kg	1,160 ug/L
Lead, Total	P122	ND(106) ug/L	319 ug/L	18.9 mg/kg	19.4 ug/L
Magnesium, Total (s)		834,000 ug/L	206,000 ug/L	10,100 mg/kg	70,800 ug/L
Manganese, Total		6,380 ug/L	1,750 ug/L	542 mg/kg	80.2 ug/L
Mercury, Total (s)	P123	ND(1.86) ug/L	ND(0.0170) ug/L	ND(0.00400) mg/kg	0.442 ug/L
Molybdenum, Total		ND(55.9) ug/L	95.0 ug/L	10.1 mg/kg	ND(1.50) ug/L
Nickel, Total	P124	1.35,000 ug/L	310 ug/L	37.1 mg/kg	27.6 ug/L
Selenium, Total (s)	P125	513 ug/L	69.0 ug/L	ND(0.0291) mg/kg	34.3 ug/L
Silver, Total	P126	350 ug/L	52.0 ug/L	9.70 mg/kg	<2.11 ug/L
Sodium, Total (s)		951,000 ug/L	697,000 ug/L	14,300 mg/kg	492,000 ug/L
Thallium, Total	P127	ND(1.17) ug/L	ND(0.00900) ug/L	ND(0.00250) mg/kg	<0.00940 ug/L
Tin, Total		ND(231) ug/L	77.0 ug/L	58.4 mg/kg	15.3 ug/L
Titanium, Total		1,300 ug/L	5.00 ug/L	1,890 mg/kg	<2.59 ug/L
Vanadium, Total		1,170 ug/L	272 ug/L	29.9 mg/kg	11.6 ug/L
Yttrium, Total		ND(11.7) ug/L	6.00 ug/L	3.40 mg/kg	ND(0.222) ug/L
Zinc, Total (s)	P128	90,400 ug/L	31,000 ug/L	1,470 mg/kg	1,430 ug/L
Volatile and Semivolatile Organics					
Bis(2-ethylhexyl) Phthalate	P066	18,500 ug/L	NC	17,600 ug/kg	31.9 ug/L
Bromomethane	P046	36.7 ug/L	ND(10.0) ug/L	NC	ND(10.0) ug/L

(a) Sampling point location; see Figure 2-2.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
NC - Not collected.
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetected value (calculation uses detection limits for nondetected results).

Table 4-11 (Continued)

Analyte	Priority Pollutant Code	Screening Solids (SP-11) (a) Day 3	Biosludge (SP-12) (a) Day 1	Incinerator Ash (SP-13) (a) Day 3	Average Influent to Treatment (SP-4) (a)
Chloroform	P023	ND(5.04) ug/L	ND(10.0) ug/L	NC	ND(10.0) ug/L
Methylene Chloride	P044	ND(5.04) ug/L	ND(10.0) ug/L	NC	<10.1 ug/L
Phenol (s)	P065	822 ug/L	NC	976 ug/kg	149 ug/L
Tetrachloroethene	P085	12.0 ug/L	14.8 ug/L	NC	<17.8 ug/L
Toluene	P086	68.5 ug/L	ND(10.0) ug/L	NC	<10.1 ug/L
Dioxins and Furans					
1,2,3,4,6,7,8-HpCDD		NC	NC	92.9 pg/g	NC
1,2,3,4,6,7,8-HpCDF		NC	NC	292 pg/g	NC
1,2,3,4,7,8,9-HpCDF		NC	NC	31.6 pg/g	NC
1,2,3,4,7,8-HxCDD		NC	NC	12.4 pg/g	NC
1,2,3,4,7,8-HxCDF		NC	NC	92.5 pg/g	NC
1,2,3,6,7,8-HxCDD		NC	NC	22.4 pg/g	NC
1,2,3,6,7,8-HxCDF		NC	NC	104 pg/g	NC
1,2,3,7,8,9-HxCDD		NC	NC	41.0 pg/g	NC
1,2,3,7,8,9-HxCDF		NC	NC	7.30 pg/g	NC
1,2,3,7,8-PeCDD		NC	NC	20.9 pg/g	NC
1,2,3,7,8-PeCDF		NC	NC	108 pg/g	NC
2,3,4,6,7,8-HxCDF		NC	NC	118 pg/g	NC
2,3,4,7,8-PeCDF		NC	NC	129 pg/g	NC
2,3,7,8-TCDF		NC	NC	136 pg/g	NC
Octachlorodibenzo-p-dioxin		NC	NC	101 pg/g	NC
Octachlorodibenzofuran		NC	NC	76.1 pg/g	NC

(a) Sampling point location; see Figure 2-2.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
NC - Not collected.
ND - Not detected (number in parentheses is detection limit).
< - Average result includes at least one nondetected value (calculation uses detection limits for nondetected results).

Table 4-12

Source Water Analytical Results, Island Princess

Analytical results for one-time grab sample of source water for detected analytes. See Appendix A-2 for all analytical results (detected and nondetected). Also shown are Federal drinking water standards for comparison. Priority pollutants (designated by EPA in 30 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Source Water (SP-14) (a)	Federal Drinking Water Standards (b)
Classical Pollutants				
Ammonia As Nitrogen (NH3-N)	mg/L		0.0350	
Hardness	mg/L		16.9	
Total Kjeldahl Nitrogen (TKN)	mg/L		0.300	
Total and Dissolved Metals				
Calcium, Total	ug/L		6,470	
Copper, Total	ug/L	P120	412	1,300
Magnesium, Total	ug/L		191	
Mercury, Total	ug/L	P123	0.100	2.0
Selenium, Total	ug/L	P125	0.970	50
Sodium, Total	ug/L		2,110	
Zinc, Total	ug/L	P128	23.0	5,000
Calcium, Dissolved	ug/L		6,450	
Cobalt, Dissolved	ug/L		1.20	
Copper, Dissolved	ug/L	P120	479	
Iron, Dissolved	ug/L		27.9	
Magnesium, Dissolved	ug/L		197	
Manganese, Dissolved	ug/L		2.40	
Mercury, Dissolved	ug/L	P123	0.0800	
Nickel, Dissolved	ug/L	P124	2.80	
Sodium, Dissolved	ug/L		2,100	
Yttrium, Dissolved	ug/L		2.00	
Zinc, Dissolved	ug/L	P128	33.0	
Volatile and Semivolatile Organics				
Phenol	ug/L	P065	53.0	

(a) Sampling point number; see Table 2-1.
(b) 40 CFR 141.62 National Primary Maximum Contaminant Levels for Inorganic Contaminants (mercury, selenium); 40 CFR 141.51 National Primary Maximum Contaminant Level Goals for Inorganic Contaminants (copper); and 40 CFR 143.3 Secondary Maximum Contaminant Levels (zinc).

Table 4-13

Flow Data by Sampling Period, Island Princess

Flow data collected via strap-on ultrasonic flow meters installed by the sampling team. Figures 2-1and 2-2 show the flow meter locations. Note that the treatment system treats only accommodations wastewater and sewage. Flow per capita was calculated by dividing daily flow totals by the number of passengers and crew (2,925 people) onboard the Island during the sampling episode.

Sampling Period	Effluent from Treatment System (SP-6) (a)	
	Daily Total Flow, gallons/day (m^3/day)	**Daily Flow Per Capita, gallons/day/person (m^3/person)**
Day 1	126,000 (477)	43.1 (0.163)
Day 2	99,300 (376)	34.0 (0.129)
Day 3	53,900 (204) (b)	18.4 (0.070) (b)
Day 4	127,000 (482)	43.5 (0.165)
Day 5	126,000 (477)	43.0 (0.163)
Average (b)	120,000 (453) (b)	40.9 (0.155) (b)

(a) Sampling point location; see Figures 2-1and 2-2.
(b) Average daily discharge flow rate for effluent from treatment system excludes data for Day 3 when the Island discontinued discharge while it cruised Glacier Bay National Park.

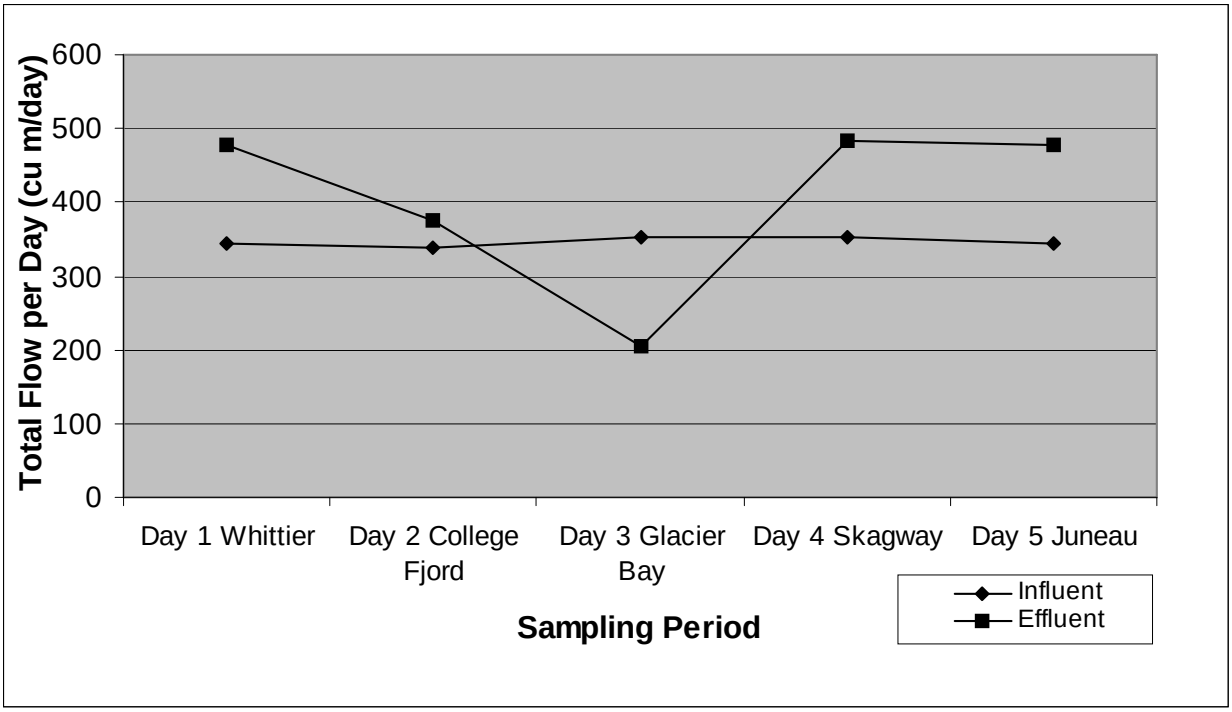

Figure 4-1. Total Daily Flow, Island Princess

Flow data collected via strap-on ultrasonic flow meters installed by the sampling team. Flow data are presented as daily totals for each location. Figures 2-1 and 2-2 show the flow meter locations. Note that the treatment treats only accommodations wastewater and sewage.

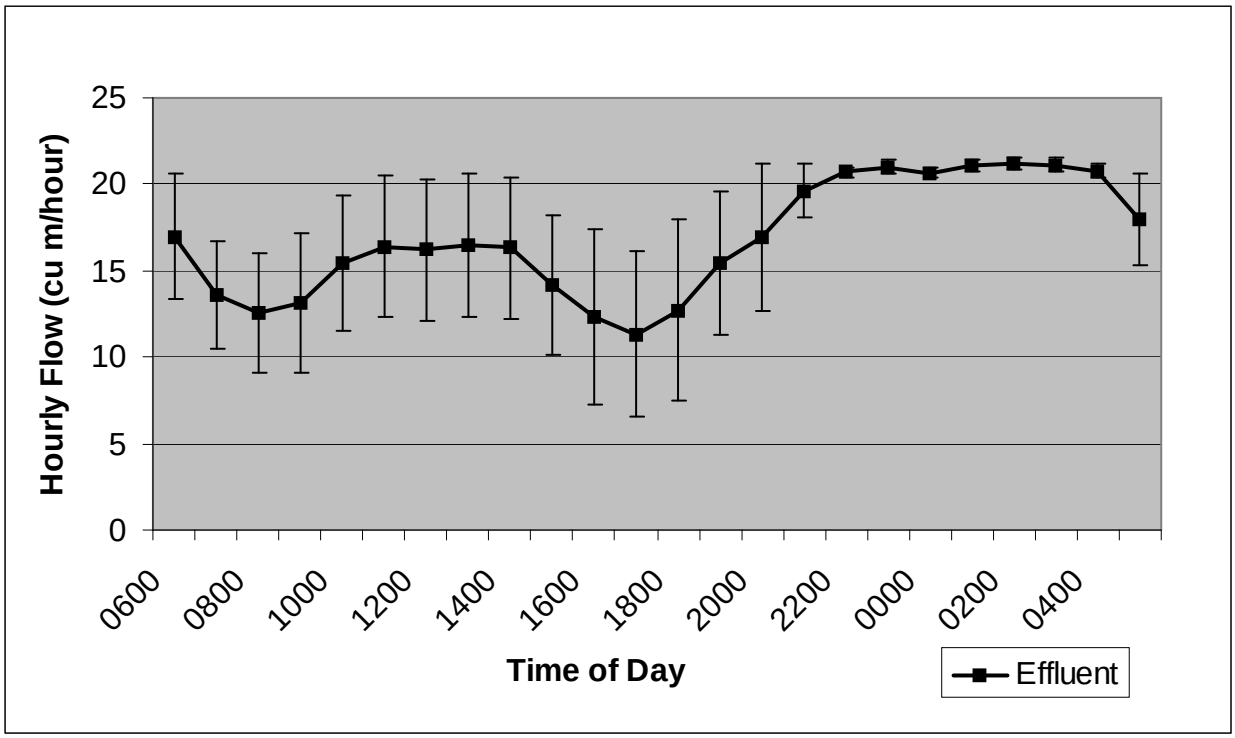

Figure 4-2. Average Hourly Wastewater Treatment System Flow, Island Princess

Average effluent flow for each hour interval over the five consecutive 24-hour sampling periods, calculated and plotted from the strap-on flow meters installed by the sampling team. Figure 2-2 shows the flow meter location. Bars represent the standard error of the hourly flow calculated for the five consecutive sampling days. Standards error is calculated as the standard deviation divided by the square root of the number of hourly flow measurements (five).

5.0 DATA QUALITY

Quality assurance/quality control (QA/QC) procedures applicable to the Island sampling episode are outlined in the *Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Waters (QAPP),* which can be found in the Cruise Ship Rulemaking Record and is available upon request. This section describes the quality control practices used to assess the precision and accuracy of the analytical data presented in Section 4.0. Quality control (QC) practices used for this sampling episode include the analysis of matrix spikes, duplicate samples, and quality control standard checks.

5.1 Analytical Quality Control

EPA verified that laboratory performace was acceptable by conducting quality d control checks of the analytical data as specified by the QAPP. Data review chemists prepared written data review narratives (Appendix D) describing any qualifications of the analytical data. The following data were not considered to be of acceptable quality for the reasons discussed in Appendix D and were excluded from the data set:

- Three organics:
  - 2-Chloroethylvinyl ether in samples 65715, 65719, 65731, and 65741,
  - Hexachlorocyclopentadiene in sample 65719, and
  - Benzidine in sample 65749.

- *E. coli,* enterococci, and fecal coliform in samples 65731, 65733, and 65737;

- Biological oxygen demand in samples 65607, 65627, 65647, 65667, 65707, and 65727; and
- Settleable residue in samples 65607, 65627, 65647, 65667, 65707, and 65727.

There was uncertainty regarding the analytical results for available and total cyanide. Although these data have not been excluded from the database, the results are presented in Table 5-1 and not in the analytical results summary tables in Section 4.1. Available cyanide was detected in many samples, while total cyanide was not detected in these samples. In theory, the total cyanide result for any given sample will be greater than the available cyanide results in the same sample. Because it was not possible to determine which analysis was correct, EPA flagged the irreconcilable results in the database to alert data users to the presence of such problems (see memoranda *Data Review Narrative for Classical Analytes for the Alaska Cruise Ship Industry Episode 6505* and *Issues Associated with Results for Total Cyanide Versus Available Cyanide* in Appendix D for a complete discussion).

EPA did not identify any known source of cyanide onboard the Island during its onboard interviews regarding activities that impact wastewater generation.

5.2 Field Quality Control

The trip blank, equipment blank, and field duplicate results are the field QA/QC measures discussed in this subsection. Section 3.8 of the Island SAP discusses field QC specifications. Tables presented in this section include results for only those analytes detected in the respective field QC samples during the sampling episode. Appendices A-1 and A-2 contain the results for all analytes, both detected and nondetected.

5.2.1 Trip Blank

A trip blank was collected and analyzed for volatile organics to evaluate possible contamination during shipment and handling of samples. This sample consisted of high performance liquid chromatography (HPLC) water. The trip blank was prepared prior to the

start of the sampling episode, and accompanied samples shipped to the laboratory on September 2, 2004.

No volatile organics were detected in the trip blank, indicating that there was no contamination of samples during transport, field handling, storage, or shipping. (Note that there is no table with the results of the analyses in this section of the report because all results are nondetects.)

5.2.2 Equipment Blank

The sampling team collected an equipment blank to assess the potential introduction of contaminants by sample collection equipment. The sample collection equipment used to collect the equipment blank was the same as that used at the sampling points: approximately 4 feet of Teflon® tubing connected on one end to a series of metal plumbing fixtures installed on each sample port, and the other end to a small segment of silicone tubing used in the peristaltic pump mechanism of the automatic sampler. The equipment blank was collected by pumping HPLC water through this equipment directly into sample bottles.

Table 5-2 presents the detected results for the equipment blank. Six total metals and seven dissolved metals were detected in the equipment blank. In tables presenting the analytical results in Section 4.1, all 13 of these metals and hardness are flagged with an "(e)" to indicate they were detected in the equipment blank. EPA will consider the impact of possible contamination from equipment in a future analysis.

5.2.3 Field Duplicates

Field duplicate samples were collected to assess the precision of the entire sample collection, handling, preparation, and analysis process. The relative percent difference (RPD) between the two duplicate sample results is calculated and compared to the data quality objective. For this program, the QAPP provides an RPD target of field duplicate samples as less than 30% for all analytes of a specific analytical method.

Classical Pollutants, Total and Dissolved Metals, and Semivolatile Organics

For classical pollutants, total and dissolved metals, and semivolatile organics, field duplicate samples were samples collected from the same source, at the same time, then stored and analyzed independently. The duplicate samples were collected as split samples poured from the same mixed sample composite jars to minimize sample wastestream variability. Duplicate samples for these analytes were collected from the effluent from the wastewater treatment system (SP-6/7). Note that duplicate samples for dioxin and furans and pesticide analytes were collected during a previous sampling episode, and duplicate samples for HEM/SGT-HEM were not planned for this sampling program.

Table 5-3 presents analytical results and the RPDs for these duplicate samples and includes analytical results for only those analytes that were detected at least once in wastewater samples during the sampling episode.

There was excellent precision in sampling and analysis for this sampling episode. Of the 207 duplicate pairs listed in Table 5-3, 178 either achieved the RPD target, or the RPD could not be calculated because both of the duplicate samples were less than the detection limit. The RDP could not be calculated for 18 of the duplicate pairs because the analyte was detected in one sample but not the other. Analytical variability increases as analyte concentrations approach their detection limits. The 11 duplicate pairs with an RDP outside of the target (i.e., $\geq$30% difference) include one of the three duplicate pairs for each of total aluminum, total iron, total nickel, total selenium, and phenol, one of four duplicate pairs for dissolved sodium, two of three duplicate pairs for total mercury, and three of four duplicate pairs for dissolved selenium. These results are not uncommon in complex wastewater samples.

In tables presenting the analytical results in Section 4.1, duplicate sample results are presented as averages (calculation uses detection limits for nondetected results).

Pathogen Indicators and Volatile Organics

For pathogen indicators and volatile organics, field duplicate samples were collected sequentially and not as split samples as was done for the other analytes. For these samples, this methodology introduced sample wastestream variability into the assessment of the precision of sample collection and analysis. Duplicate samples for these analytes were collected from the effluent from the treatment system (SP-6/7). Table 5-4 presents analytical results and the RPDs for these duplicate samples. Of the 42 duplicate pairs, 41 either achieved the RPD target, or the RPD could not be calculated because both of the duplicate samples were less than the detection limit. The RDP could not be calculated for one of the duplicate pairs because the analyte, *E. coli*, was detected in one sample but not the other. Analytical variability increases as analyte concentrations approach their detection limits.

In tables presenting the analytical results in Section 4.1, duplicate sample results are presented as averages (calculation uses detection limits for nondetected results). In the case of pathogen indicators, average daily results presented incorporate both duplicate grab samples and multiple grab samples collected for individual analysis during each 24-hour sampling period. First, duplicate results, where applicable, were averaged to determine the average individual grab sample results for that sample (e.g., grab 1 duplicate sample results for Day 3 were averaged together to represent the average grab 1 sample result for Day 3). Next, the individual grab sample results for each day were averaged to calculate the average daily pathogen indicators results presented in the tables (e.g., grab sample results 1 through 3 for Day 3 were averaged together to calculate the average Day 3 pathogen indicators sample results). In this way, the average daily pathogen indicators results presented in the tables are weighted equally by time of day, rather than weighted more heavily by the particular time of day when duplicate grab samples were collected.

Table 5-1

Available and Total Cyanide Analytical Results, Island Princess

Available and total cyanide analytical results are irreconcilable; see Section 5.1.

Waste Stream	Available Cyanide (ug/L)	Total Cyanide (mg/L)
Galley (SP-1), Day 1	ND(2.00)	ND(0.00500)
Galley (SP-1), Day 2	ND(2.00)	ND(0.00500)
Galley (SP-1), Day 3	ND(2.00)	ND(0.00500)
Galley (SP-1), Day 4	2.23	ND(0.00500)
Galley (SP-1), Day 5	2.84	ND(0.00500)
Laundry (SP-2), Day 1	NC	ND(0.00500)
Laundry (SP-2), Day 2	ND(2.00)	ND(0.00500)
Laundry (SP-2), Day 3	ND(2.00)	ND(0.00500)
Laundry (SP-2), Day 4	ND(2.00)	ND(0.00500)
Laundry (SP-2), Day 5	ND(2.00)	ND(0.00500)
Accommodations (SP-3), Day 1	3.13	ND(0.00500)
Accommodations (SP-3), Day 2	ND(2.00)	ND(0.00500)
Accommodations (SP-3), Day 3	ND(2.00)	ND(0.00500)
Accommodations (SP-3), Day 4	2.28	ND(0.00500)
Accommodations (SP-3), Day 5	ND(2.00)	ND(0.00500)
Influent to Treatment (SP-4), Day 1	ND(2.00)	ND(0.00500)
Influent to Treatment (SP-4), Day 2	ND(2.00)	ND(0.00500)
Influent to Treatment (SP-4), Day 3	30.7	ND(0.00500)
Influent to Treatment (SP-4), Day 4	ND(2.00)	ND(0.00500)
Influent to Treatment (SP-4), Day 5	ND(2.00)	ND(0.00500)
Effluent from Treatment (SP-6), Day 1	ND(2.00)	ND(0.00500)
Effluent from Treatment (SP-6), Day 2	ND(2.00)	ND(0.00500)
Effluent from Treatment (SP-6), Day 3	ND(2.00)	ND(0.00500)
Effluent from Treatment (SP-6), Day 4	ND(2.00)	ND(0.00500)
Effluent from Treatment (SP-6), Day 5	ND(2.00)	ND(0.00500)
Screening Solids (SP-11)	149	ND(1.00)
Biosludge (SP-12)	15.2	0.0110
Source Water (SP-14)	ND(2.00)	ND(0.00500)

ND - Not detected (number in parentheses is detection limit).
NC - Not collected.

Table 5-2

Equipment Blank Analytical Results, Island Princess

Analytical results for analytes detected in the equipment blank. See Appendix A-2 for all analytical results (detected and nondetected). The equipment blank was collected as a one-time grab sample. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Equipment Blank (SP-16)
Total and Dissolved Metals			
Barium, Total	ug/L		4.00
Beryllium, Total	ug/L	P117	0.150
Lead, Total	ug/L	P122	4.00
Manganese, Total	ug/L		2.00
Mercury, Total	ug/L	P123	0.0200
Zinc, Total	ug/L	P128	11.0
Barium, Dissolved	ug/L		28.3
Copper, Dissolved	ug/L	P120	3.60
Lead, Dissolved	ug/L	P122	23.7
Manganese, Dissolved	ug/L		1.10
Mercury, Dissolved	ug/L	P123	0.0200
Thallium, Dissolved	ug/L	P127	0.0200
Zinc, Dissolved	ug/L	P128	25.8

Table 5-3

Field Duplicate Analytical Results for Classical Pollutants, Total and Dissolved Metals, and Semivolatile Organics, Island Princess

Field duplicate analytical results for classical pollutants, total and dissolved metals, and semivolatile organics, detected at least once in wastewater samples during the sampling episode. See Appendix A-2 for all field duplicate analytical results (detected and nondetected). Field duplicate samples for these analytes are split samples collected from the same source, at the same time, stored and analyzed independently. See Figure 2-2 for sampling point locations. Also listed are the average result and relative percent difference calculated for each duplicate pair. Priority pollutants (designed by EPA in 40 CFR Part 423) are listed where applicable.

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Classical Pollutants								
Alkalinity	mg/L		65699	65719	218	211	215	3.3
Alkalinity	mg/L		65703	65723	203	179	191	13
Alkalinity	mg/L		65707	65727	204	203	204	0.49
Ammonia As Nitrogen (NH3-N) (s)	mg/L		65699	65719	46.0	48.6	47.3	5.5
Ammonia As Nitrogen (NH3-N) (s)	mg/L		65703	65723	38.2	38.0	38.1	0.52
Ammonia As Nitrogen (NH3-N) (s)	mg/L		65707	65727	42.3	42.8	42.6	1.2
Available Cyanide	ug/L		65691	65711	ND (2.00)	ND (2.00)	ND (2.00)	NC
Available Cyanide	ug/L		65695	65715	ND (2.00)	ND (2.00)	ND (2.00)	NC
Available Cyanide	ug/L		65699	65719	ND (2.00)	ND (2.00)	ND (2.00)	NC
Biochemical Oxygen Demand (BOD_5)	mg/L		65691	65711	ND (2.00)	ND (2.00)	ND (2.00)	NC
Biochemical Oxygen Demand (BOD_5)	mg/L		65695	65715	ND (2.00)	ND (2.00)	ND (2.00)	NC
Biochemical Oxygen Demand (BOD_5)	mg/L		65707	65727	EXCLUDE	EXCLUDE	EXCLUDE	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Chemical Oxygen Demand (COD)	mg/L		65699	65719	76.0	71.0	73.5	6.8
Chemical Oxygen Demand (COD)	mg/L		65703	65723	61.0	68.0	64.5	11
Chemical Oxygen Demand (COD)	mg/L		65707	65727	67.0	67.0	67.0	0.0
Chloride	mg/L		65699	65719	1,320	1,310	1,320	0.76
Chloride	mg/L		65703	65723	942	962	952	2.1
Chloride	mg/L		65707	65727	797	787	792	1.3
Hardness (s)	mg/L		65691	65711	307	313	310	1.9
Hardness (s)	mg/L		65695	65715	356	362	359	1.7
Hardness (s)	mg/L		65703	65723	332	325	329	2.1
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		65699	65719	ND (0.0500)	ND (0.0500)	ND (0.0500)	NC
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		65703	65723	ND (0.0500)	ND (0.0500)	ND (0.0500)	NC
Nitrate/Nitrite (NO2-N + NO3-N)	mg/L		65707	65727	ND (0.0500)	ND (0.0500)	ND (0.0500)	NC
Settleable Residue	mL/L		65691	65711	ND (0.100)	ND (0.100)	ND (0.100)	NC
Settleable Residue	mL/L		65695	65715	ND (0.100)	ND (0.100)	ND (0.100)	NC
Settleable Residue	mL/L		65753	65764	ND (0.100)	ND (0.100)	ND (0.100)	NC
Settleable Residue	mL/L		65707	65727	EXCLUDE	EXCLUDE	EXCLUDE	NC
Sulfate	mg/L		65699	65719	182	178	180	2.2
Sulfate	mg/L		65703	65723	128	130	129	1.6
Sulfate	mg/L		65707	65727	112	108	110	3.6

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Total Cyanide	mg/L	P121	65691	65711	ND (0.00500)	ND (0.00500)	ND (0.00500)	NC
Total Cyanide	mg/L	P121	65695	65715	ND (0.00500)	ND (0.00500)	ND (0.00500)	NC
Total Cyanide	mg/L	P121	65699	65719	ND (0.00500)	ND (0.00500)	ND (0.00500)	NC
Total Dissolved Solids (TDS)	mg/L		65699	65719	2,540	2,650	2,600	4.2
Total Dissolved Solids (TDS)	mg/L		65703	65723	1,530	1,850	1,690	19
Total Dissolved Solids (TDS)	mg/L		65707	65727	1,550	1,600	1,580	3.2
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		65699	65719	54.3	52.0	53.2	4.3
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		65703	65723	44.1	43.5	43.8	1.4
Total Kjeldahl Nitrogen (TKN) (s)	mg/L		65707	65727	46.8	46.0	46.4	1.7
Total Organic Carbon (TOC)	mg/L		65699	65719	16.0	16.9	16.5	5.5
Total Organic Carbon (TOC)	mg/L		65703	65723	14.0	15.3	14.7	8.9
Total Organic Carbon (TOC)	mg/L		65707	65727	16.0	14.4	15.2	11
Total Phosphorus	mg/L		65699	65719	8.10	8.10	8.10	0.0
Total Phosphorus	mg/L		65703	65723	7.80	7.10	7.45	9.4
Total Phosphorus	mg/L		65707	65727	7.90	8.60	8.25	8.5
Total Suspended Solids (TSS)	mg/L		65699	65719	ND (5.00)	ND (5.00)	ND (5.00)	NC
Total Suspended Solids (TSS)	mg/L		65703	65723	ND (5.00)	ND (5.00)	ND (5.00)	NC
Total Suspended Solids (TSS)	mg/L		65707	65727	32.0	ND (5.00)	< 18.5	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Total and Dissolved Metals								
Aluminum, Total	ug/L		65691	65711	28.0	ND (9.93)	< 19.0	NC
Aluminum, Total	ug/L		65695	65715	62.0	35.0	48.5	56
Aluminum, Total	ug/L		65703	65723	ND (9.93)	ND (9.93)	ND (9.93)	NC
Aluminum, Dissolved	ug/L		65691	65711	ND (9.93)	46.5	< 28.2	NC
Aluminum, Dissolved	ug/L		65695	65715	ND (9.93)	ND (9.93)	ND (9.93)	NC
Aluminum, Dissolved	ug/L		65699	65719	ND (9.93)	ND (9.93)	ND (9.93)	NC
Aluminum, Dissolved	ug/L		65703	65723	53.6	46.1	49.9	15
Antimony, Total	ug/L	P114	65691	65711	ND (5.97)	ND (5.97)	ND (5.97)	NC
Antimony, Total	ug/L	P114	65695	65715	ND (5.97)	ND (5.97)	ND (5.97)	NC
Antimony, Total	ug/L	P114	65703	65723	ND (5.97)	ND (5.97)	ND (5.97)	NC
Barium, Total (e)	ug/L		65691	65711	6.00	6.00	6.00	0.0
Barium, Total (e)	ug/L		65695	65715	6.00	6.00	6.00	0.0
Barium, Total (e)	ug/L		65703	65723	4.50	4.30	4.40	4.5
Barium, Dissolved (e)	ug/L		65691	65711	6.00	6.10	6.05	1.7
Barium, Dissolved (e)	ug/L		65695	65715	6.30	6.70	6.50	6.2
Barium, Dissolved (e)	ug/L		65699	65719	5.80	5.80	5.80	0.0
Barium, Dissolved (e)	ug/L		65703	65723	4.50	4.60	4.55	2.2
Beryllium, Total (e)	ug/L	P117	65691	65711	ND (0.0540)	ND (0.0540)	ND (0.0540)	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Beryllium, Total (e)	ug/L	P117	65695	65715	ND (0.0540)	ND (0.0540)	ND (0.0540)	NC
Beryllium, Total (e)	ug/L	P117	65703	65723	ND (0.0540)	ND (0.0540)	ND (0.0540)	NC
Boron, Total	ug/L		65691	65711	306	327	317	6.6
Boron, Total	ug/L		65695	65715	348	343	346	1.4
Boron, Total	ug/L		65703	65723	353	340	347	3.8
Boron, Dissolved	ug/L		65691	65711	294	335	315	13
Boron, Dissolved	ug/L		65695	65715	365	366	366	0.27
Boron, Dissolved	ug/L		65699	65719	385	391	388	1.5
Boron, Dissolved	ug/L		65703	65723	335	ND (3.37)	< 169	NC
Cadmium, Total	ug/L	P118	65691	65711	ND (0.446)	ND (0.446)	ND (0.446)	NC
Cadmium, Total	ug/L	P118	65695	65715	ND (0.446)	ND (0.446)	ND (0.446)	NC
Cadmium, Total	ug/L	P118	65703	65723	ND (0.446)	ND (0.446)	ND (0.446)	NC
Calcium, Total (s)	ug/L		65691	65711	28,600	28,900	28,800	1.0
Calcium, Total (s)	ug/L		65695	65715	31,700	32,000	31,900	0.94
Calcium, Total (s)	ug/L		65703	65723	31,600	30,900	31,300	2.2
Calcium, Dissolved (s)	ug/L		65691	65711	28,400	29,100	28,800	2.4
Calcium, Dissolved (s)	ug/L		65695	65715	33,800	33,800	33,800	0.0
Calcium, Dissolved (s)	ug/L		65699	65719	37,700	38,000	37,900	0.79
Calcium, Dissolved (s)	ug/L		65703	65723	31,100	31,000	31,100	0.32

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Chromium, Total	ug/L	P119	65691	65711	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Total	ug/L	P119	65695	65715	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Total	ug/L	P119	65703	65723	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Dissolved	ug/L	P119	65691	65711	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Dissolved	ug/L	P119	65695	65715	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Dissolved	ug/L	P119	65699	65719	ND (1.68)	ND (1.68)	ND (1.68)	NC
Chromium, Dissolved	ug/L	P119	65703	65723	ND (1.68)	ND (1.68)	ND (1.68)	NC
Cobalt, Total	ug/L		65691	65711	ND (0.914)	ND (0.914)	ND (0.914)	NC
Cobalt, Total	ug/L		65695	65715	1.00	ND (0.914)	< 0.957	NC
Cobalt, Total	ug/L		65703	65723	ND (0.914)	ND (0.914)	ND (0.914)	NC
Cobalt, Dissolved (s)	ug/L		65691	65711	ND (0.914)	1.20	< 1.06	NC
Cobalt, Dissolved (s)	ug/L		65695	65715	ND (0.914)	ND (0.914)	ND (0.914)	NC
Cobalt, Dissolved (s)	ug/L		65699	65719	ND (0.914)	ND (0.914)	ND (0.914)	NC
Cobalt, Dissolved (s)	ug/L		65703	65723	2.00	ND (0.914)	< 1.46	NC
Copper, Total (s)	ug/L	P120	65691	65711	15.0	15.4	15.2	2.6
Copper, Total (s)	ug/L	P120	65695	65715	19.0	18.0	18.5	5.4
Copper, Total (s)	ug/L	P120	65703	65723	15.5	15.0	15.3	3.3
Copper, Dissolved (e) (s)	ug/L	P120	65691	65711	13.2	14.5	13.9	9.4
Copper, Dissolved (e) (s)	ug/L	P120	65695	65715	17.2	17.6	17.4	2.3

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Copper, Dissolved (e) (s)	ug/L	P120	65699	65719	12.4	13.7	13.1	10
Copper, Dissolved (e) (s)	ug/L	P120	65703	65723	14.0	14.8	14.4	5.6
Iron, Total	ug/L		65691	65711	164	165	165	0.61
Iron, Total	ug/L		65695	65715	175	175	175	0.0
Iron, Total	ug/L		65703	65723	272	143	208	62
Iron, Dissolved (s)	ug/L		65691	65711	ND (19.8)	163	< 91.4	NC
Iron, Dissolved (s)	ug/L		65695	65715	ND (19.8)	ND (19.8)	ND (19.8)	NC
Iron, Dissolved (s)	ug/L		65699	65719	ND (19.8)	ND (19.8)	ND (19.8)	NC
Iron, Dissolved (s)	ug/L		65703	65723	148	168	158	13
Lead, Total (e)	ug/L	P122	65691	65711	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Total (e)	ug/L	P122	65695	65715	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Total (e)	ug/L	P122	65703	65723	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65691	65711	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65695	65715	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65699	65719	ND (3.08)	ND (3.08)	ND (3.08)	NC
Lead, Dissolved (e)	ug/L	P122	65703	65723	ND (3.08)	ND (3.08)	ND (3.08)	NC
Magnesium, Total (s)	ug/L		65691	65711	57,300	58,500	57,900	2.1
Magnesium, Total (s)	ug/L		65695	65715	67,200	68,400	67,800	1.8
Magnesium, Total (s)	ug/L		65703	65723	61,500	60,100	60,800	2.3

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Magnesium, Dissolved (s)	ug/L		65691	65711	56,800	58,200	57,500	2.4
Magnesium, Dissolved (s)	ug/L		65695	65715	73,200	73,200	73,200	0.0
Magnesium, Dissolved (s)	ug/L		65699	65719	77,800	78,200	78,000	0.51
Magnesium, Dissolved (s)	ug/L		65703	65723	60,800	60,600	60,700	0.33
Manganese, Total (e)	ug/L		65691	65711	19.0	19.4	19.2	2.1
Manganese, Total (e)	ug/L		65695	65715	19.0	19.0	19.0	0.0
Manganese, Total (e)	ug/L		65703	65723	18.8	18.1	18.5	3.8
Manganese, Dissolved (e) (s)	ug/L		65691	65711	21.5	20.6	21.1	4.3
Manganese, Dissolved (e) (s)	ug/L		65695	65715	23.2	24.3	23.8	4.6
Manganese, Dissolved (e) (s)	ug/L		65699	65719	24.0	22.2	23.1	7.8
Manganese, Dissolved (e) (s)	ug/L		65703	65723	20.3	18.5	19.4	9.3
Mercury, Total (e) (s)	ug/L	P123	65691	65711	0.0200	0.0300	0.0250	40
Mercury, Total (e) (s)	ug/L	P123	65695	65715	0.0200	0.0900	0.0550	130
Mercury, Total (e) (s)	ug/L	P123	65703	65723	0.0300	0.0300	0.0300	0.0
Mercury, Dissolved (e) (s)	ug/L	P123	65691	65711	ND (0.0170)	0.0400	< 0.0285	NC
Mercury, Dissolved (e) (s)	ug/L	P123	65695	65715	ND (0.0170)	ND (0.0170)	ND (0.0170)	NC
Mercury, Dissolved (e) (s)	ug/L	P123	65699	65719	ND (0.0170)	ND (0.0170)	ND (0.0170)	NC
Mercury, Dissolved (e) (s)	ug/L	P123	65703	65723	0.0300	ND (0.0170)	< 0.0235	NC
Nickel, Total	ug/L	P124	65691	65711	12.0	13.2	12.6	9.5

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Nickel, Total	ug/L	P124	65695	65715	12.0	11.0	11.5	8.7
Nickel, Total	ug/L	P124	65703	65723	18.7	12.4	15.6	41
Nickel, Dissolved (s)	ug/L	P124	65691	65711	12.4	13.2	12.8	6.2
Nickel, Dissolved (s)	ug/L	P124	65695	65715	11.7	11.0	11.4	6.2
Nickel, Dissolved (s)	ug/L	P124	65699	65719	19.4	19.2	19.3	1.0
Nickel, Dissolved (s)	ug/L	P124	65703	65723	13.7	14.5	14.1	5.7
Selenium, Total (s)	ug/L	P125	65691	65711	26.0	15.8	20.9	49
Selenium, Total (s)	ug/L	P125	65695	65715	29.0	26.0	27.5	11
Selenium, Total (s)	ug/L	P125	65703	65723	32.8	31.5	32.2	4.0
Selenium, Dissolved	ug/L	P125	65691	65711	49.2	14.7	32.0	110
Selenium, Dissolved	ug/L	P125	65695	65715	34.8	52.3	43.6	40
Selenium, Dissolved	ug/L	P125	65699	65719	77.2	67.0	72.1	14
Selenium, Dissolved	ug/L	P125	65703	65723	35.7	23.8	29.8	40
Silver, Total	ug/L	P126	65691	65711	ND (1.28)	ND (1.28)	ND (1.28)	NC
Silver, Total	ug/L	P126	65695	65715	ND (1.28)	ND (1.28)	ND (1.28)	NC
Silver, Total	ug/L	P126	65703	65723	ND (1.28)	ND (1.28)	ND (1.28)	NC
Sodium, Total (s)	ug/L		65691	65711	488,000	512,000	500,000	4.8
Sodium, Total (s)	ug/L		65695	65715	575,000	591,000	583,000	2.7
Sodium, Total (s)	ug/L		65703	65723	514,000	496,000	505,000	3.6

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Sodium, Dissolved (s)	ug/L		65691	65711	619,000	472,000	546,000	27
Sodium, Dissolved (s)	ug/L		65695	65715	1,350,000	629,000	990,000	73
Sodium, Dissolved (s)	ug/L		65699	65719	681,000	666,000	674,000	2.2
Sodium, Dissolved (s)	ug/L		65703	65723	480,000	480,000	480,000	0.0
Thallium, Total	ug/L	P127	65691	65711	ND (0.00900)	0.0100	< 0.00950	NC
Thallium, Total	ug/L	P127	65695	65715	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Thallium, Total	ug/L	P127	65703	65723	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Thallium, Dissolved (e)	ug/L	P127	65691	65711	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Thallium, Dissolved (e)	ug/L	P127	65695	65715	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Thallium, Dissolved (e)	ug/L	P127	65699	65719	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Thallium, Dissolved (e)	ug/L	P127	65703	65723	ND (0.00900)	ND (0.00900)	ND (0.00900)	NC
Tin, Total	ug/L		65691	65711	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Total	ug/L		65695	65715	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Total	ug/L		65703	65723	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Dissolved	ug/L		65691	65711	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Dissolved	ug/L		65695	65715	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Dissolved	ug/L		65699	65719	ND (3.45)	ND (3.45)	ND (3.45)	NC
Tin, Dissolved	ug/L		65703	65723	ND (3.45)	ND (3.45)	ND (3.45)	NC
Titanium, Total	ug/L		65691	65711	ND (0.253)	ND (0.253)	ND (0.253)	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Titanium, Total	ug/L		65695	65715	ND (0.253)	ND (0.253)	ND (0.253)	NC
Titanium, Total	ug/L		65703	65723	ND (0.253)	ND (0.253)	ND (0.253)	NC
Titanium, Dissolved	ug/L		65691	65711	ND (0.253)	ND (10.0)	ND (5.13)	NC
Titanium, Dissolved	ug/L		65695	65715	ND (0.253)	ND (0.253)	ND (0.253)	NC
Titanium, Dissolved	ug/L		65699	65719	ND (0.253)	ND (0.253)	ND (0.253)	NC
Titanium, Dissolved	ug/L		65703	65723	ND (10.0)	ND (10.0)	ND (10.0)	NC
Vanadium, Total	ug/L		65691	65711	ND (0.679)	1.10	< 0.890	NC
Vanadium, Total	ug/L		65695	65715	ND (0.679)	ND (0.679)	ND (0.679)	NC
Vanadium, Total	ug/L		65703	65723	0.830	ND (0.679)	< 0.755	NC
Vanadium, Dissolved	ug/L		65691	65711	ND (0.679)	1.50	< 1.09	NC
Vanadium, Dissolved	ug/L		65695	65715	ND (0.679)	ND (0.679)	ND (0.679)	NC
Vanadium, Dissolved	ug/L		65699	65719	ND (0.679)	1.10	< 0.890	NC
Vanadium, Dissolved	ug/L		65703	65723	ND (0.679)	0.710	< 0.695	NC
Zinc, Total (e) (s)	ug/L	P128	65691	65711	211	233	222	9.9
Zinc, Total (e) (s)	ug/L	P128	65695	65715	217	211	214	2.8
Zinc, Total (e) (s)	ug/L	P128	65703	65723	230	221	226	4.0
Zinc, Dissolved (e) (s)	ug/L	P128	65691	65711	218	227	223	4.0
Zinc, Dissolved (e) (s)	ug/L	P128	65695	65715	209	208	209	0.48
Zinc, Dissolved (e) (s)	ug/L	P128	65699	65719	150	151	151	0.66

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-3 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Zinc, Dissolved (e) (s)	ug/L	P128	65703	65723	220	224	222	1.8
Semivolatile Organics								
Bis(2-ethylhexyl) Phthalate	ug/L	P066	65691	65711	ND (10.0)	ND (10.0)	ND (10.0)	NC
Bis(2-ethylhexyl) Phthalate	ug/L	P066	65695	65715	ND (10.0)	16.7	< 13.4	NC
Bis(2-ethylhexyl) Phthalate	ug/L	P066	65699	65719	18.9	ND (10.0)	< 14.5	NC
Phenol (s)	ug/L	P065	65691	65711	81.4	90.2	85.8	10
Phenol (s)	ug/L	P065	65695	65715	84.0	52.3	68.2	47
Phenol (s)	ug/L	P065	65699	65719	111	106	109	4.6

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
(e) Analyte detected at some level in the equipment blank. See Section 5.2.2 and Table 5-2 for equipment blank results.
(s) Analyte detected at some level in the source water. See Section 4.1.7 and Table 4-12 for source water results.
EXCLUDE - Data excluded from the data set (see data review narratives in Appendix D for details).
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit .
< - Average result includes at least one nondetect value (calculation uses detection limits for nondetected results).

Table 5-4

Field Duplicate Analytical Results for Pathogen Indicators and Volatile Organics, Island Princess

Field duplicate analytical results presented for pathogen indicators and volatile organics detected at least once during the sampling episode. Field duplicate samples were collected sequentially from the same source, stored and analyzed independently. See Figure 2-2 for sampling point locations. Also listed are the average result and relative percent difference calculated for each duplicate pair. Priority pollutants (designated by EPA in 40 CFR Part 423, Appendix A) are identified where applicable.

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Pathogen Indicators								
E. coli	MPN/100 mL		65691	65766	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65691	65711	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65695	65715	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65695	65763	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65699	65719	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65699	65765	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65703	65767	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65703	65723	ND (1.00)	ND (1.00)	ND (1.00)	NC
E. coli	MPN/100 mL		65703	65762	ND (1.00)	1.00	ND (1.00)	NC
Enterococci	MPN/100 mL		65691	65711	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65691	65766	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65695	65715	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65695	65763	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65699	65765	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65699	65719	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65703	65723	ND (1.00)	ND (1.00)	ND (1.00)	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit.

Table 5-4 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Enterococci	MPN/100 mL		65703	65762	ND (1.00)	ND (1.00)	ND (1.00)	NC
Enterococci	MPN/100 mL		65703	65767	ND (1.00)	ND (1.00)	ND (1.00)	NC
Fecal Coliform	CFU/100 mL		65691	65711	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65691	65766	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65695	65763	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65695	65715	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65699	65765	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65699	65719	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65703	65762	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65703	65723	ND (2.00)	ND (2.00)	ND (2.00)	NC
Fecal Coliform	CFU/100 mL		65703	65767	ND (2.00)	ND (2.00)	ND (2.00)	NC
Volatile Organics								
Chloroform	ug/L	P023	65691	65711	ND (10.0)	ND (10.0)	ND (10.0)	NC
Chloroform	ug/L	P023	65695	65715	ND (10.0)	ND (10.0)	ND (10.0)	NC
Chloroform	ug/L	P023	65699	65719	ND (10.0)	ND (10.0)	ND (10.0)	NC
Methylene Chloride	ug/L	P044	65691	65711	ND (10.0)	ND (10.0)	ND (10.0)	NC
Methylene Chloride	ug/L	P044	65695	65715	ND (10.0)	ND (10.0)	ND (10.0)	NC
Methylene Chloride	ug/L	P044	65699	65719	ND (10.0)	ND (10.0)	ND (10.0)	NC
Tetrachloroethene	ug/L	P085	65691	65711	ND (10.0)	ND (10.0)	ND (10.0)	NC
Tetrachloroethene	ug/L	P085	65695	65715	ND (10.0)	ND (10.0)	ND (10.0)	NC
Tetrachloroethene	ug/L	P085	65699	65719	ND (10.0)	ND (10.0)	ND (10.0)	NC
Toluene	ug/L	P086	65691	65711	ND (10.0)	ND (10.0)	ND (10.0)	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit.

Table 5-4 (Continued)

Analyte	Unit	Priority Pollutant Code	Sample Numbers (a)		Original Effluent from Treatment (SP-6) (b)	Duplicate Effluent from Treatment (SP-7) (b)	Average	Relative Percent Difference
Toluene	ug/L	P086	65695	65715	ND (10.0)	ND (10.0)	ND (10.0)	NC
Toluene	ug/L	P086	65699	65719	ND (10.0)	ND (10.0)	ND (10.0)	NC

(a) Sample numbers identify corresponding analytical results in Appendix A-2.
(b) Sampling point location; see Figure 2-2.
ND - Not detected (number in parentheses is detection limit).
NC - Not calculated because one or both of the sample results is less than the laboratory detection limit.

6.0 REFERENCES

1. Metcalf & Eddy, 1991. *Wastewater Engineering*, Third Edition.

2. ATSDR, 2002. Agency for Toxic Substances and Disease Registry, *ToxFAQs™ for Di(2-ethylhexyl)phthalate (DEHP)*. Available Online: www.atsdr.cdc.gov.

3. ATSDR, 2001. Agency for Toxic Substances and Disease Registry, *ToxFAQs™ for Methylene Chloride*. Available Online: www.atsdr.cdc.gov.

4. ATSDR, 1997. Agency for Toxic Substances and Disease Registry, *ToxFAQs™ for Tetrachloroethylene*. Available Online: www.atsdr.cdc.gov.

5. ATSDR, 2001. Agency for Toxic Substances and Disease Registry, *ToxFAQs™ for Toluene*. Available Online: www.atsdr.cdc.gov.

6. ATSDR, 1998. Agency for Toxic Substances and Disease Registry, *Public Health Statement for Phenol*. Available Online: www.atsdr.cdc.gov.

7. Extoxnet, 1996. *Pesticide Information Profiles; Simazine*. Oregon State University. Available Online: http://extoxnet.orst.edu/

8. U.S. EPA, 2005. *Polychlorinated Biphenyls (PCBs) Home Page*. Available Online: http://www.epa.gov/pcb/.