

2019 Large Cruise Ship Wastewater Sampling Report

COMMERCIAL PASSENGER VESSEL ENVIRONMENTAL
COMPLIANCE (CPVEC) PROGRAM



November 2019

Revision 1



Alaska Department of Environmental Conservation

Abbreviations:

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AMHS	Alaska Marine Highway System (State Ferry System)
AS	Alaska Statutes
AWTS	Advanced Wastewater Treatment Systems
BMP	Best Management Practices
BOD	Biological Oxygen Demand (sampled parameter)
BW	Blackwater
CLIA	Cruise Lines International Association
COD	Chemical Oxygen Demand (sampled parameter)
FC	Fecal Coliform (sampled parameter)
GW	Graywater
MSD	Marine Sanitation Device
ND	Non-detect value
QAPP	Quality Assurance Project Plan
SC	Specific Conductance (sampled parameter)
LCPV	Large Commercial Passenger Vessel
TSS	Total Suspended Solids (sampled parameter)
VSSP	Vessel Specific Sampling Plan

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Revision Notes

Appendix B in Original Report was missing values, specifically Exceedance values (colored cells). Revision 1 shows those values.

INTRODUCTION

Forty large cruise ships operated in Alaska in 2019, of those twenty four ships were authorized to discharge treated wastewater in Alaska and eighteen ships discharged treated wastewater and conducted sampling. Table 1 lists wastewater treatment systems onboard large cruise ships and 2019 authorized discharges in Alaska.

This report summarizes 2019 onboard sampling and laboratory testing results of large cruise ship treated wastewater effluent in Alaska. Effluent sampling requirements are contained within the [2014 Large Commercial Passenger Vessel Wastewater Discharge General Permit](#) (General Permit).

Sampling of wastewater effluent is a requirement under the General Permit for all large cruise ships discharging in Alaska waters. Sampling is needed to:

- Check for compliance of permit effluent limits
- Obtain information on treatment system performance for future discharge permits
- Compile information on potential environmental effects

Tables 2-4 contain sample results for each vessel. Sample result data for cruise ships has been collected by the Department of Environmental Conservation since 2000. Reports for prior years can be found on the cruise program's report webpage:

<https://dec.alaska.gov/water/cruise-ships/cruise-reports/>

Table 1. 2019 Large Cruise Ship Voyages and Passenger Counts

Vessel Operator	Vessel (n = 40)	Passenger Capacity¹	Voyages	Annual Passenger capacity²	Crew Capacity
Azamara	<i>Azamara Quest</i>	700	10	7,000	400
Carnival Cruise Lines	<i>Carnival Legend</i>	2124	21	44,604	930
Celebrity Cruises	<i>Celebrity Eclipse</i>	3148	19	59,812	1270
Celebrity Cruises	<i>Celebrity Millennium</i>	2449	18	44,082	1000
Celebrity Cruises	<i>Celebrity Solstice</i>	3148	18	56,664	1250
Crystal	<i>Crystal Symphony</i>	975	13	12,675	545
Cunard Line	<i>Queen Elizabeth</i>	2081	4	8,324	1000
Disney Cruise Line	<i>Disney Wonder</i>	2834	17	48,178	920
Holland America	<i>Amsterdam</i>	1380	9	12,420	647
Holland America	<i>Eurodam</i>	2106	21	44,226	929
Holland America	<i>Maasdam</i>	1380	4	5,520	580
Holland America	<i>Nieuw Amsterdam</i>	2106	21	44,226	929
Holland America	<i>Noordam</i>	1916	20	38,320	800
Holland America	<i>Oosterdam</i>	1916	21	40,236	Unknown
Holland America	<i>Volendam</i>	1432	20	28,640	647
Holland America	<i>Westerdam</i>	1916	21	40,236	800
Hurtigruten	<i>Road Amundson</i>	530	2	1,060	Unknown
Norwegian Cruise Line	<i>Norwegian Bliss</i>	3500	21	73,500	1706
Norwegian Cruise Line	<i>Norwegian Jewel</i>	2376	21	49,896	1100
Norwegian Cruise Line	<i>Norwegian Joy</i>	3500	22	77,000	1706
NYK	<i>Asuka</i>	680	1	680	Unknown
Oceania	<i>Regatta</i>	777	11	8,547	373
Ponant	<i>L' Austral</i>	264	2	528	136
Ponant	<i>Le Boreal</i>	264	2	528	136
Ponant	<i>Le Soleal</i>	264	8	2,112	136
Princess Cruise Line	<i>Coral Princess</i>	1986	20	39,720	900
Princess Cruise Line	<i>Golden Princess</i>	2606	21	54,726	1060
Princess Cruise Line	<i>Grand Princess</i>	2606	14	36,484	1100
Princess Cruise Line	<i>Island Princess</i>	1974	20	39,480	900
Princess Cruise Line	<i>Royal Princes</i>	3560	19	67,640	1378
Princess Cruise Line	<i>Ruby Princess</i>	3084	20	61,680	1201
Princess Cruise Line	<i>Star Princess</i>	2600	20	52,000	1150
Princess Cruise Line	<i>Sun Princess</i>	1974	1	1,974	924
Regent Seven Seas	<i>Seven Seas Mariner</i>	769	18	13,842	431
ResidenSea	<i>The World</i>	450	1	450	280
Royal Caribbean Cruises	<i>Ovation of the Seas</i>	4180	18	75,240	1551
Royal Caribbean Cruises	<i>Radiance of the Seas</i>	2502	17	42,534	859
Seabourn	<i>Sojourn</i>	450	11	4,950	338
Silver Seas	<i>Silver Muse</i>	596	16	9,536	417
Viking	<i>Viking Orion</i>	930	10	9,300	499
		Totals	573	1,258,570	

Vessels highlighted in gray above indicated to ADEC that they would not discharge wastewater in AK waters.

¹ Capacity is the number of lower berths; Actual number of passenger aboard varies.

² Assumes full capacity on every voyage

METHODS

Samples are grab wastewater samples taken from a sample port prior to discharge. The number of required samples and what parameters are required to be analyzed are listed in the 2014 General Permit and for the US Coast Guard in the Quality Assurance Project Plan (QAPP). Sampling may occur while underway or while the cruise ship is docked. All samples were obtained in Southeast Alaska in 2018, with the majority of samples obtained in or near Juneau. Sample results presented in this report only include data collected while a cruise ship was discharging in Alaska.

The samples were taken according to requirements in the 2019 Cruise Line International Association Alaska Quality Assurance Project Plan for Sampling and Analysis of Treated Sewage and Graywater from Commercial Passenger Vessels (QAPP). The QAPP specifies minimum requirements for sampling and analysis of wastewater. It includes a list of approved methods, sample collection requirements, and laboratory analysis requirements. Samplers must follow the QAPP and the Vessel Specific Sampling Plan (VSSP) for each cruise ship when collecting a sample. The Commercial Passenger Vessel Environmental Compliance (Cruise Ship) program spot checked results submitted by the cruise ship operators for compliance with the QAPP and checked all results for compliance with 2014 General Permit limits.

RESULTS

Table 3 and 4 provide summary data for effluent parameters measured. 2019 wastewater sampling results are listed in Appendix B. The number of samples received (n) are noted in each table. Non-detect (ND) values are entered as zeros¹ and summary statistics are biased low (Helsel 1990). In the tables of results red and orange highlighted cells indicate exceedances of the 2014 Wastewater Discharge General Permit limits.

Appendix B includes results for copper, nickel, and zinc; additional dissolved metal data is available on request. Table 4 provides summary data for other dissolved metals sampled.

Sampling for Priority parameters [volatile organic compounds (VOCs) and base neutral acids (BNAs)], and Nutrients are not required with every sample. Priority/ Nutrients sampling results are not provided in this report, but are available upon request.

¹ To be consistent with large cruise ship data, requiring calculation of geometric means. Metal non-detects are still reported as NDs

Whole Effluent Toxicity effluent testing and receiving water was conducted in 2019 and will be presented in a standalone report.

Table 2. 2019 Large Cruise Ship Summary Data, Mixed WW Effluent

Mixed WW (n=206)						
	AVG ($\pm$ SE)	Count (n)	Median	Min	Max	Std Dev
Flow rate (m3/hr)	19.7 ($\pm$ 1.0)	200	16.4	0.1	65.0	13.6
Temperature (C)	29.9 ($\pm$ 0.3)	206	29.6	16.9	43.9	4.6
pH (S.U.)	7.25 ($\pm$ 0.03)	206	7.25	6.01	8.49	0.48
Free Cl (mg/L)	0	205	0	0	0	0
Total Cl (mg/L)	0	205	0	0	0.10	0.01
Fecal Coliform (FC/100mL)	16 ($\pm$ 6)	202	0	0	600	84
BOD (mg/L)	5 ($\pm$ 1)	204	3	0	76	9
TSS (mg/L)	2 ($\pm$ 0)	204	0	0	26	4
Ammonia (mg/L)	34 ($\pm$ 3)	108	31	0	180	32
Specific Conductance (umhos/ cm)	1295 ($\pm$ 121)	105	998	291	7260	1242
Hardness (mg/L)	59 ($\pm$ 7)	101	36	0	450	71
Dissolved Copper (μ g/L)	10 ($\pm$ 2)	101	4	0	200	23
Dissolved Nickel (μ g/L)	10 ($\pm$ 1)	39	9	0.2	24	6
Dissolved Zinc (μ g/L)	65 ($\pm$ 10)	40	54	2.0	310	63
Total Settleable Solids (mg/L)	3 ($\pm$ 2)	41	0	0	96	15
COD (mg/L)	61 ($\pm$ 6)	40	50	0	170	37
E.coli (MPN/ 100mL)	21 ($\pm$ 19)	45	0	0	870	130
NO ₂ / NO ₃ (mg/L)	14 ($\pm$ 6)	46	1	0	260	40
Total Kjeldahl Nitrogen (mg/L)	41 ($\pm$ 6)	44	40	0	180	39
Phosphorus (μ g/L)	2.59 ($\pm$ 0.42)	44	1.87	0	13.90	2.81

Table 3. 2019 Large Cruise Ship Summary Data, GW Effluent

GW (n=54)						
	AVG ($\pm$ SE)	Count (n)	Median	Min	Max	Std Dev
Flow rate (m3/hr)	13.0 ($\pm$ 0.8)	48	12.0	4.0	27.9	5.4
Temperature (C)	30.3 ($\pm$ 0.4)	54	30.3	25.1	36.3	2.8
pH (S.U.)	6.98 ($\pm$ 0.06)	54	7.04	5.31	8.00	0.41
Free Cl (mg/L)	0	54	0	0	0	0
Total Cl (mg/L)	0	54	0	0	0	0
Fecal Coliform (FC/100mL)	0	54	0	0	15	2
BOD (mg/L)	5 ($\pm$ 1)	53	0	0	42	8
TSS (mg/L)	0	53	0	0	0	0
Ammonia (mg/L)	5 ($\pm$ 3)	50	0	0	170	24
Specific Conductance (umhos/ cm)	1259 ($\pm$ 334)	51	409	181	15400	2390
Hardness (mg/L)	116 ($\pm$ 37)	49	32	5.6	1600	256
Dissolved Copper (μ g/L)	5 ($\pm$ 1)	49	2	0	49	8
Dissolved Nickel (μ g/L)	11 ($\pm$ 1)	9	11	7.5	13	2
Dissolved Zinc (μ g/L)	85 ($\pm$ 17)	9	97	18	170	50
Total Settleable Solids (mg/L)	0	10	0	0	0	0
COD (mg/L)	49 ($\pm$ 12)	10	42	0	110	38
E.coli (MPN/ 100mL)	0	10	0	0	3	1
NO ₂ / NO ₃ (mg/L)	3 ($\pm$ 2)	10	0	0	13	5
Total Kjeldahl Nitrogen (mg/L)	20 ($\pm$ 18)	9	1	0	160	53
Phosphorus (μ g/L)	1.58 ($\pm$ 1.06)	9	0.24	0	9.80	3.18

Table 4. 2019 Large Cruise Ship Summary, Additional Metals Analyzed

	Dissolved Metals (n=48)									
	Antimony (µg/L)	Arsenic (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Lead (µg/L)	Selenium (µg/L)	Silver (µg/L)	Thallium (µg/L)	Mercury (µg/L)
Average	0.20	0.28	0.00	0.00	0.70	0.14	0.06	0.00	0.00	0.00
Max	1.50	2.10	0.11	0.10	2.70	3.10	1.60	0.05	0.10	0.00

REFERENCES

Helsel, D.R. (1990). Less than obvious; statistical treatment of data below the detection limit.
Environ. Sci. Technol 24(12);1767-1774.

ONLINE RESOURCES

Alaska Department of Environmental Conservation (ADEC) Cruise Ship Program

<http://dec.alaska.gov/water/cruise-ships/>

2014 Large Cruise Ship General Permit

<http://dec.alaska.gov/water/cruise-ships/cruise-general-permit/>

Quality Assurance Project Plan

<http://dec.alaska.gov/media/5198/2018-clia-qapp.pdf>

Alaska Cruise Ship Laws and Regulations

<http://dec.alaska.gov/water/cruise-ships/laws-regs/>

Sample reports from prior years

<http://dec.alaska.gov/water/cruise-ships/cruise-reports/>

APPENDIX A: LARGE PASSENGER VESSEL INFORMATION

Vessel Operator	Vessel (n = 24)	Wastewater Treatment System ¹	UV	Permitted to discharge to Alaska Waters ² in 2019		Skagway Discharge Authorized		
				Underway	Stationary	Railroad	Ore	Broadway
Celebrity Cruises	<i>Celebrity Millennium</i>	Hydroxyl CB-100 MSD	Yes	Yes	No	No	No	No
Cunard Line	<i>Queen Elizabeth</i>	2 Hamworthy 320 MBR AWTS	Yes	Yes	No	No	No	No
Disney Cruise Line	<i>Disney Wonder</i>	2 Hamworthy MBR AWTS	Yes	Yes	No	No	No	No
Holland America	<i>Eurodam</i>	2x Hamworthy 360N MBR AWTS	Yes	Yes	No	No	No	No
Holland America	<i>Maasdam</i>	Zenon AWTS	Yes	Yes	Yes	Yes	No	No
Holland America	<i>Nieuw Amsterdam</i>	2x Hamworthy 360N MBR AWTS	Yes	Yes	No	No	No	No
Holland America	<i>Volendam</i>	Zenon AWTS		Yes	Yes	Yes	Yes	Yes
Norwegian Cruise Line	<i>Norwegian Bliss</i>	Scanship AWP 60 AWTS	Yes	Yes	Yes	Yes	No	No
Norwegian Cruise Line	<i>Norwegian Jewel</i>	Scanship AWTS Mussel FA45	Yes	Yes	Yes	Yes	Yes	Yes
Norwegian Cruise Line	<i>Norwegian Joy</i>	Scanship AWP 60 AWTS	Yes	Yes	Yes	Yes	No	No
Oceania	<i>Regatta</i>	2x Triton Water MBR AWTS	Yes	Yes	Yes	Yes	Yes	Yes
Ponant	<i>Le Soleal</i>	Rochem Bio-filt AWTS		Yes	Yes	Yes	Yes	Yes*
Princess Cruise Line	<i>Coral Princess</i>	2x Hamworthy MBR AWTS		Yes	No	No	No	No
Princess Cruise Line	<i>Golden Princess</i>	3x Hamworthy MBR AWTS		Yes	Yes - Graywater only	Yes	No	No
Princess Cruise Line	<i>Grand Princess</i>	3x Hamworthy MBR 16 AWTS		Yes	Yes	Yes	No	No
Princess Cruise Line	<i>Island Princess</i>	2x Hamworthy MBR AWTS		Yes	No	No	No	No
Princess Cruise Line	<i>Royal Princes</i>	2x Hamworthy MBR AWTS		Yes	Yes - Graywater only	Yes	No	No
Princess Cruise Line	<i>Ruby Princess</i>	3x Hamworthy MBR 16 AWTS		Yes	Yes - Graywater only	No	No	No
Princess Cruise Line	<i>Star Princess</i>	3x Hamworthy MBR AWTS		Yes	Yes - Graywater only	No	No	No
Princess Cruise Line	<i>Sun Princess</i>	3x Hamworthy MBR AWTS		Yes	No	No	No	No
Regent Seven Seas	<i>Seven Seas Mariner</i>	2x Hamworthy MBR 240C AWTS		Yes	No	No	No	No
Royal Caribbean Cruises	<i>Ovation of the Seas</i>	Scanship AWP 60 AWTS		Yes	No	No	No	No
Seabourn	<i>Sojourn</i>	2x Hamworthy 140 MBR AWTS		Yes	Yes	Yes	Yes	Yes
Viking	<i>Viking Orion</i>	Scanship AWP-25 AWTS		Yes	Yes	Yes	No	No

¹ MBR is a Membrane Bioreactor, MSD is a Marine Sanitation Device. AWTS is an Advanced Wastewater Treatment System.

² Extending 3 miles from the coastline; including the Alexander Archipelago. Only discharging vessels are required to sample wastewater.

⁴ Assumes full capacity on every voyage

* Discharge at Broadway Dock allowed unless another ship is discharging at the Ore Dock

APPENDIX B: WASTEWATER RESULTS

[The following 6 pages provide Large Cruise Ship effluent results for the 2019 season.]

Color Key for Wastewater Results:

	Parameter Result Exceeds Daily Maximum in Large Cruise Ship GP.
	Exceedance of both Daily & Monthly GP Limits for Parameter.
	Parameters not tested or failed Quality Assurance (e.g. holding time not met).
"value"	Outlier flow rates from lab field data (i.e. determined by using 1.5x Quartile Range method), not used for Summary Statistics.

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/ NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)	
2019 Mixed Effluent (Sewage and GW)																											
Disney	Wonder	Mixed	UW	05/24/19	GP	AE 22359	14.40	29.8	6.29	0	0	0	0	0													
Disney	Wonder	Mixed	UW	06/07/19	PP	AE 22457	14.58	28.8	6.85	0	0	0	0	0	0	514	20	40	14	260	0	30	0	2.9	0	2.16	
Disney	Wonder	Mixed	UW	06/21/19	GP	AE 22655	14.58	29.4	6.87	0	0	0	0	0													
Disney	Wonder	Mixed	UW	07/12/19	GP	AE 22756	16.56	28.1	6.98	0	0	0	0	0													
Disney	Wonder	Mixed	UW	07/26/19	GP	AE 22897	16.44	27.9	6.42	0	0	0	0	0													
Disney	Wonder	Mixed	UW	08/09/19	PP	AE 23097	13.68	29.1	7.02	0	0	0	0	0	8.5	564	34	45	3.1	310	0	25	0	11	5.2	5.57	
Disney	Wonder	Mixed	UW	08/23/19	GP	AE 23239	13.86	27.8	6.79	0	0	0	0	0													
Disney	Wonder	Mixed	UW	09/06/19	GP	AE 23401	0.03	26.2	6.73	0	0	0	0	0													
Disney	Wonder	Mixed	UW	09/13/19	GP	AE 23462	4.8	29.6	6.56	0	0	0	0	0													
Celebrity	Millenium	Mixed	UW	05/15/19	PP	AE 22282	17.00	25.2	7.56	0	0	600	22	9.6	58	846	17	11	6.7	66	0	97	0	2.3	61	2.43	
Celebrity	Millenium	Mixed	UW	05/29/19	GP	AE 22485	17.00	29.8	7.43	0	0	2	2.2	4													
Celebrity	Millenium	Mixed	UW	06/12/19	GP	AE 22626	17.00	42.5	6.96	0	0.1		3.5	0													
Celebrity	Millenium	Mixed	ST	06/16/19	GP	AE 22640	17.00	35.0	7.57	0	0	2	6.7	0													
HAL	Eurodam	Mixed	UW	05/06/19	GP	AE 22157	30.00	29.5	7.88	0	0	2	12	0													
HAL	Eurodam	Mixed	UW	05/29/19	PP	AE 22424	18.23	29.7	7.67	0	0	0	11	0	97	1050	25	2.9	8.8	14	0	82	0	0	87	1.81	
HAL	Eurodam	Mixed	UW	06/03/19	GP	AE 22438	14.63	29.6	8.48	0	0	0	8.2	0													
HAL	Eurodam	Mixed	UW	06/24/19	GP	AE 22568	16.20	31.2	7.9	0	0	22	14	0													
HAL	Eurodam	Mixed	UW	07/08/19	GP	AE 22739	15.95	32.7	7.6	0	0	0	15	0													
HAL	Eurodam	Mixed	UW	07/15/19	GP	AE 22859	11.60	27	7.52	0	0	0	10	0													
HAL	Eurodam	Mixed	UW	08/05/19	PP	AE 22996	12.63	30.8	7.52	0	0	3	9.4	0	95	1190	35	2.0	18	14	0	140	0	0	75	3.7	
HAL	Eurodam	Mixed	UW	08/14/19	GP	AE 23112	17.63	31.9	7.68	0	0	0	6.6	0													
HAL	Eurodam	Mixed	UW	09/02/19	GP	AE 23253	13.74	29.6	7.58	0	0	0	6.1	0													
HAL	Eurodam	Mixed	UW	09/18/19	GP	AE23466	10.77	32.2	7.36	0	0	0	8.0	0													
HAL	Maasdam	Mixed	ST	05/19/19	GP	AE 22350	14.54	26.4	7.27	0	0	23	0	0	50	916	23	2.4									
HAL	Maasdam	Mixed	ST	05/21/19	GP	AE 22338	8.05	25.00	7.25	0	0	100	0	0	58	998	28	6.8									
HAL	Maasdam	Mixed	ST	06/09/19	PP	AE 22510	16.50	25.60	7.34	0	0	0	0	0	41	842	25	3.8	21	72	0	40	0	0	41	2.20	
HAL	Maasdam	Mixed	ST	06/10/19	GP	AE 22615	9.78	27.2	7.5	0	0	0	0	0	53	931	27	4.6									
HAL	Maasdam	Mixed	ST	07/01/19	PP	AE 22722	8.51	28.5	7.05	0	0	0	0	0	52	1110	36	3.1	24	50	0	55	0	0	47	1.58	
HAL	Maasdam	Mixed	ST	07/15/19	GP	AE 22863	15.90	28.8	7.4	0	0	0	0	0	47	905	26	2.8									
HAL	Nieuw Amsterdam	Mixed	UW	05/14/19	GP	AE 22175	22.68	29.5	7.58	0	0	0	9.8	0													
HAL	Nieuw Amsterdam	Mixed	UW	05/21/19	GP	AE 22342	25.33	18.6	7.92	0	0	0	2.8	10													
HAL	Nieuw Amsterdam	Mixed	UW	06/04/19	PP	AE 22445	21.99	29.5	7.43	0	0	0	11	0	83	1130	47	0.18	0.23	2	0	55	1.0	0	90	1.23	
HAL	Nieuw Amsterdam	Mixed	UW	06/18/19	GP	AE 22643	9.72	30.9	7.2	0	0	0	14	0													
HAL	Nieuw Amsterdam	Mixed	UW	07/02/19	GP	AE 22723	10.00	31.7	7.55	0	0	0	8.3	0													
HAL	Nieuw Amsterdam	Mixed	UW	07/16/19	GP	AE 22865	3.66	31.3	7.64	0	0	0	5.8	0													
HAL	Nieuw Amsterdam	Mixed	UW	08/06/19	PP	AE 23004	19.16	28.3	7.32	0	0	0	5.6	0	78	890	24	3.5	9.1	34	0	47	0	0	57	3.42	
HAL	Nieuw Amsterdam	Mixed	UW	08/20/19	GP	AE 23226	22.30	27.9	7.57	0	0	0	11	0													
HAL	Nieuw Amsterdam	Mixed	UW	09/10/19	GP	AE 23534	13.2204	31.0	7.56	0	0	0	0	0													
HAL	Nieuw Amsterdam	Mixed	UW	09/17/19	GP	AE 23467	14.65	29.9	7.55	0	0	0	14	0													
HAL	Volendam	Mixed	ST	05/10/19	PP	AE 22170	12.00	25.0	7.00	0	0	0	0	0	12	685	19	14	15	95	0	32	0	0	13	2.78	
HAL	Volendam	Mixed	ST	05/24/19	GP	AE 22361	21.49	25.3	7.43	0	0	0	8.3	0	35	892	32	1.9									
HAL	Volendam	Mixed	ST	06/07/19	GP	AE 22609	30.00	21.2	7.4	0	0	0	0	0	31	739	26	1.3									
HAL	Volendam	Mixed	ST	06/21/19	GP	AE 22711	28.00	27.2	7.42	0	0	0	0	0	41	841	18	1.9									
HAL	Volendam	Mixed	ST	07/05/19	GP	AE 22738	28.00	27.1	7.03	0	0	0	4.9	0	45	849	29	2.3									

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/ NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)
HAL	Volendam	Mixed	ST	07/19/19	GP	AE 22880	28.00	25.2	7.39	0	0	0	0	0	51	977	28	6.8								
HAL	Volendam	Mixed	ST	08/02/19	GP	AE 22980	28.00	27.5	7.45	0	0	0	0	0	46	1130	28	3.9								
HAL	Volendam	Mixed	ST	08/09/19	PP	AE 23103	13.40	21.5	7.5	0	0	0	0	0	54	1010	31	4.2	14	54	0	50	0	0	53	2.31
HAL	Volendam	Mixed	ST	09/06/19	GP	AE 23405	28.00	26.8	7.59	0	0	0	0	0	43	890	29	2.8								
HAL	Volendam	Mixed	ST	09/20/19	GP	AE 23476 R1	18.49	25.3	7.42	0	0	0	0	0	50	990	29	2.8								
Norwegian	Bliss	Mixed	ST	05/21/19	GP	AE 22348	47.40	28.8	6.85	0	0	0	0	0	63	1300	84	2.8								
Norwegian	Bliss	Mixed	ST	05/28/19	GP	AE 22426	41.60	28.7	7.07	0	0	0	2	0	37	979	61	2.1								
Norwegian	Bliss	Mixed	ST	06/05/19	PP	AE 22595	41.60	32	6.93	0	0	0	4	0	17	859	58	1.5	3.3	100	0	44	0	3.7	44	0
Norwegian	Bliss	Mixed	ST	06/18/19	GP	AE 22648	41.60	28.8	6.92	0	0	2	4.1	0	31	915	57	3.1								
Norwegian	Bliss	Mixed	ST	07/02/19	GP	AE 22729	41.60	31.1	6.82	0	0	0	4	0	24	844	61	1.3								
Norwegian	Bliss	Mixed	ST	07/16/19	PP	AE 22869	48.40	31.5	7.05	0	0	18	3.2	0	39	989	55	2.8	3.5	88	0	53	26	5.4	38	0
Norwegian	Bliss	Mixed	ST	08/06/19	GP	AE 23007	64.00	30.1	6.9	0	0	0	7.7	8	38	947	59	1.6								
Norwegian	Bliss	Mixed	ST	08/20/19	GP	AE 23232	65.00	30.1	7.01	0	0	600	5.2	7.2	40	1010	58	2.3								
Norwegian	Bliss	Mixed	ST	09/10/19	GP	AE 23416	41.50	30.3	6.96	0	0	0	0	0	27	878	52	4.0								
Norwegian	Bliss	Mixed	ST	09/17/19	GP	AE 23469	35	29.8	6.86	0	0	0	2.1	0	30	942	56	3.1								
Norwegian	Jewel	Mixed	ST	05/16/19	GP	AE 22189	24.00	26.6	6.59	0	0	0	4.3	0	31	991	52	2.2								
Norwegian	Jewel	Mixed	ST	05/23/19	GP	AE 22357	28.38	26.4	7.1	0	0	0	5.7	6	32	899	60	2.0								
Norwegian	Jewel	Mixed	ST	06/06/19	PP	AE 22456	30.48	30.3	6.96	0	0	0	6.5	4.8	32	1020	86	1.3	3.8	36	0	56		0	35	0
Norwegian	Jewel	Mixed	ST	06/20/19	GP	AE 22656	32.30	28.4	7.07			110	10	4	33.8	892	35	5.7								
Norwegian	Jewel	Mixed	ST	07/11/19	GP	AE 22757	21.02	29.6	6.5	0	0	0	5.4	4.8	33	1070	88	0.99								
Norwegian	Jewel	Mixed	ST	07/18/19	GP	AE 22879	27.60	29.8	6.6	0	0	0	4.6	0	44	1200	81	2.2								
Norwegian	Jewel	Mixed	ST	08/01/19	PP	AE 22977	25.92	28.3	6.72	0	0	0	4.4	0	44	1640	130	0	4.4	13	0	76	0	0	43	0
Norwegian	Jewel	Mixed	ST	08/07/19	USCG	AE 23283	33.60	26.6	6.01	0	0	0	2.8	21												
Norwegian	Jewel	Mixed	ST	08/22/19	GP	AE 23240	28.62	28.2	6.46	0	0	0	4.3	5.6	33	1320	100	0								
Norwegian	Jewel	Mixed	ST	09/05/19	GP	AE 23400	27.00	27.5	6.37	0	0	0	3.0	0	17	1760	64	0								
Norwegian	Jewel	Mixed	ST	09/19/19	GP	AE 23474	29.64	27.1	6.32	0	0	0	3.8	4.0	37	1150	78	1.2								
Norwegian	Jewel	Mixed	ST	10/02/19	GP	AE 23627	36.00	25.8	6.36	0	0	0	4.3	0	56	1110	57	0					0	0	57	0
Norwegian	Joy	Mixed	ST	05/06/19	GP	AE 22519	44.20	27.3	7.15	0	0	0	11	4	29	803	47	7								
Norwegian	Joy	Mixed	ST	05/14/19	PP	AE 22181	41.60	30	6.69	0	0	2	3.3	6.4	5.9	605	31	5.5	3.6	66	0	51	0	13	7.0	0
Norwegian	Joy	Mixed	ST	06/04/19	GP	AE 22449	51.90	30.1	6.6	0	0	0	2.7	5.2	1.6	543	28	5.8								
Norwegian	Joy	Mixed	ST	06/11/19	GP	AE 22621	43.50	29.3	6.76	0	0	0	2.9	4.4	0	548	34	7.8								
Norwegian	Joy	Mixed	ST	07/09/19	GP	AE 22747	52.0	30.3	6.59	0	0	0	2.6	6	3.7	573	29	7.3								
Norwegian	Joy	Mixed	ST	07/16/19	GP	AE 22870	46.0	28.9	6.88	0	0	0	3.2	6.8	3.5	574	28	9.4								
Norwegian	Joy	Mixed	ST	08/06/19	PP	AE 23008	47.0	29.6	6.46	0	0	0	0	0	0	540	24	6.8	5.4	83	0	35	0	6.8	45	0
Norwegian	Joy	Mixed	ST	08/13/19	GP	AE 23120	48.0	31.2	6.4	0	0	0	0	4.4	0	549	27	7								
Norwegian	Joy	Mixed	ST	09/10/19	GP	AE 23417	41.0	31.3	6.26	0	0	0	0	0	0	552	21	3.7								
Norwegian	Joy	Mixed	ST	09/17/19	GP	AE 23471	47.0	29.4	6.50	0	0	0	0	0	0	622	26	5.3								
Ponant	Le Soleal	Mixed	ST	07/20/19	GP	AE 22882	3.00	26.2	7.64	0	0	0	0	0	88	1700	36	31						16	96	4.88
Ponant	Le Soleal	Mixed	ST	08/03/19	GP	AE 22997	2.50	26.3	7.25	0	0	370	0	0	14	993	26	260								
Princess	Coral	Mixed	ST	08/04/19	GP	AE 22995	16.13	42	6.81	0	0	0	0	0												
Princess	Golden	Mixed	UW	05/10/19	GP	AE 22163	16.80	31.6	7.65	0	0	0	0	0												
Princess	Golden	Mixed	UW	05/21/19	PP	AE 22347	15.30	30.5	7.45	0	0	0	0	0	84	677	35	14	12	170	0	50	0	2	82	5.98
Princess	Golden	Mixed	UW	06/12/19	GP	AE 22620	22.50	30.6	7.65	0	0	0	0	0												
Princess	Golden	Mixed	UW	06/19/19	GP	AE 22645	16.32	30.5	6.99	0	0	0	0	0												
Princess	Golden	Mixed	UW	07/10/19	PP	AE 22750	9.96	33.9	7.96	0	0	0	0	0	36	588	54	12	9.5	96	0	0	0	15	37	3.08

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/ NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)
Princess	Golden	Mixed	UW	07/17/19	GP	AE 22867	7.08	30.7	8.34	0	0	66	9.1	5.6												
Princess	Golden	Mixed	UW	08/07/19	GP	AE 23006	8.46	34.9	7.11	0	0	0	0	0												
Princess	Golden	Mixed	UW	08/21/19	GP	AE 23231	14.34	33.2	7.41	0	0	0	0	0												
Princess	Golden	Mixed	UW	09/04/19	GP	AE 23394	12.00	32.0	7.32	0	0	0	0	0												
Princess	Golden	Mixed	UW	09/11/19	GP	AE 23413	11.40	32.5	7.12	0	0	0	0	0												
Princess	Grand	Mixed	UW	05/10/19	PP	AE 22164	22.31	28.8	7.52	0	0	0	2.1	0	49	7260	450	0	7	34	0	150	0	1.7	47	4.46
Princess	Grand	Mixed	UW	05/31/19	GP	AE 22433	16.19	29.1	7.83	0	0	0	2.9	0												
Princess	Grand	Mixed	UW	06/09/19	GP	AE 22611	22.89	26.61	7.81	0	0	5	6.1	0												
Princess	Grand	Mixed	UW	06/20/19	PP	AE 22650	23.56	28.6	7.8	0	0	0	7.2	0												
Princess	Grand	Mixed	UW	07/10/19	GP	AE 22745	24.89	30.5	7.68	0	0	22	6.5	0												
Princess	Grand	Mixed	UW	07/28/19	GP	AE 23132	12.39	29	7.96	0	0	0	0	0												
Princess	Grand	Mixed	UW	08/08/19	GP	AE 23094	19.44	30	7.79	0	0	3	0	0												
Princess	Grand	Mixed	UW	08/19/19	PP	AE 23223	14.70	27.6	8.01	0	0	0	2.3	0	95	4410	330	1.7	10	25	0	170	0	0	94	2.87
Princess	Grand	Mixed	UW	09/07/19	GP	AE 23402	24.64	28.6	7.81	0	0	0	0	0												
Princess	Grand	Mixed	UW	09/18/19	GP	AE 23468	20.05	27.3	7.72	0	0	0	4.1	0												
Princess	Island	Mixed	UW	05/04/19	GP	AE 22153	11.70	33.2	6.83	0	0	600	3.5	0												
Princess	Island	Mixed	UW	05/12/19	PP	AE 22172	6.60	32.6	7.18	0	0	2	0	0	7	510	36	3.5	6.2	50	0	32	0	0	6.4	2.68
Princess	Island	Mixed	UW	06/02/19	GP	AE 22440	12.79	34.5	7.32	0	0	0	0	0												
Princess	Island	Mixed	UW	06/22/19	GP	AE 22658	13.03	35.1	7.25	0	0	0	4.5	0												
Princess	Island	Mixed	UW	07/06/19	GP	AE 22730	13.79	35.6	7.18	0	0	0	0	0												
Princess	Island	Mixed	UW	07/14/19	GP	AE 22860	14.33	36.3	6.59	0	0	0	8.8	0												
Princess	Island	Mixed	UW	08/11/19	GP	AE 23105	13.98	36.4	7.08	0	0	0	0	0												
Princess	Island	Mixed	UW	08/17/19	PP	AE 23220	14.18	33.5	7.64	0	0	0	0	0	25	661	31	6.2	7.8	53	0	44	0	0	24	6.72
Princess	Island	Mixed	UW	09/01/19	GP	AE 23254	14.41	35.80	7.07	0	0	0	0	0												
Princess	Island	Mixed	UW	09/08/19	GP	AE 23407	15.00	35.3	7.06	0	0	0	0	0												
Princess	Royal	Mixed	UW	05/15/19	GP	AE 22179	5.50	26.3	7.96	0	0	0	7.1	0												
Princess	Royal	Mixed	UW	05/22/19	GP	AE 22349	18.45	28.2	7.48	0	0	0	0	0												
Princess	Royal	Mixed	UW	06/05/19	PP	AE 22451	22.46	23.4	7.93	0	0	0	8.7	0	180	1040	46	2.3	12	80	0	82	0	4.5	180	13.9
Princess	Royal	Mixed	UW	06/19/19	GP	AE 22649	22.18	26.3	7.96	0	0	0	9.3	0												
Princess	Royal	Mixed	UW	07/10/19	GP	AE 22746	20.22	31	7.68	0	0	0	5.4	0	63											
Princess	Royal	Mixed	UW	07/23/19	GP	AE 22888	9.52	29.6	7.3	0	0	0	0	0												
Princess	Royal	Mixed	UW	08/07/19	GP	AE 23009	15.00	32	7.5	0	0	0	3	0												
Princess	Royal	Mixed	UW	08/28/19	GP	AE 23234	17.67	29	7.9	0	0	0	18	0												
Princess	Royal	Mixed	UW	09/03/19	PP	AE 23393	15.91	26.3	8.00	0	0	0	14	0	170	1720	50	2.2	13	97	0	96	2.0	0.7	160	9.8
Princess	Royal	Mixed	UW	09/11/19	GP	AE 23419	21.71	24.8	8.04	0	0	0	21	0												
Princess	Royal	Mixed	UW	09/23/19	GP	AE 23599	14.22	33.1	8.05	0	0	0	26	0												
Princess	Ruby	Mixed	UW	04/28/19	GP	AE 22027	6.15	28.2	7.78	0	0	0	76	0												
Princess	Ruby	Mixed	UW	05/28/19	GP	AE 22478	18.52	30.8	8.05	0	0	0	10	0												
Princess	Ruby	Mixed	UW	06/04/19	GP	AE 22446	2.4	29.5	7.6	0	0	0	6.2	0												
Princess	Ruby	Mixed	UW	06/11/19	PP	AE 22618	17.20	29.4	7.48	0	0		40	0	43	1101	19	3.1	15	62	0	88	0	0	50	3.58
Princess	Ruby	Mixed	UW	06/18/19	GP	AE 22694	18.10	29.1	7.61	0	0	0	0	0	39								0	0	43	3.25
Princess	Ruby	Mixed	UW	07/02/19	GP	AE 22724	19.10	31.1	7.49	0	0	0	0	0												
Princess	Ruby	Mixed	UW	07/23/19	PP	AE 22889	17.50	32.4	7.56	0	0	0	8.9	0	62	1070	24	4	13	120	0	96	3.0	0	61	0.955
Princess	Ruby	Mixed	UW	08/13/19	GP	AE 23113	1.3	32.6	7.95	0	0	0	5.6	0												
Princess	Ruby	Mixed	UW	08/20/19	GP	AE 23227	8.82	29.8	8.24	0	0	0	2.9	0												

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)	
Princess	Ruby	Mixed	UW	09/03/19	GP	AE 23389	27.00	30.8	7.6	0	0	0	15	0													
Princess	Ruby	Mixed	UW	09/10/19	GP	AE 23411	68.6	31.0	8.02	0	0	0	7.5	0													
Princess	Star	Mixed	UW	05/02/19	GP	AE 22150	24.66	33.7	7.19	0	0	0	6.2	0													
Princess	Star	Mixed	UW	05/16/19	PP	AE 22184	22.82	36.1	7.96	0	0	0	47	0	40	888	33	0	11	45	0	95	0	0	41	1.26	
Princess	Star	Mixed	UW	06/06/19	GP	AE 22452	20.37	34.1	6.75	0	0	0	15	0													
Princess	Star	Mixed	UW	06/13/19	GP	AE 22631	25.85	33.4	6.47	0	0	0	25	0													
Princess	Star	Mixed	UW	07/18/19	GP	AE 22873	24.60	34.3	6.77	0	0		4.5	0													
Princess	Star	Mixed	UW	07/25/19	GP	AE 22895	18.18	33.9	6.73	0	0	0	9.8	0													
Princess	Star	Mixed	UW	08/15/19	PP	AE 23126	24.43	35.2	6.71	0	0	0	4.3	0	0	291	23	0	11	27	0	50	0	0	3.1	0	
Princess	Star	Mixed	UW	08/22/19	GP	AE 23237	18.45	34.4	6.69	0	0	0	9.6	0													
Princess	Star	Mixed	UW	08/29/19	GP	AE 23384	17.76	33.4	6.96	0	0	0															
Princess	Star	Mixed	UW	09/05/19	GP	AE 23395	22.85	31.2	6.74	0	0	0	5.2	0													
Princess	Star	Mixed	UW	09/12/19	GP	AE 23460	19.61	35.9	7.12	0	0	0	14	0													
Oceania	Regatta_Port	Mixed	ST	05/25/19	GP	AE 22417	2.03	16.9	8.49	0	0	0	14	4.8	140	7230	330	47									
Oceania	Regatta_Port	Mixed	ST	06/26/19	GP	AE 22799	2.18	25.2	7.08	0	0	68	2.2	4	7.7	833	25	18									
Oceania	Regatta_Port	Mixed	UW	07/12/19	GP	AE 22969	53.30	22.6	7.99	0	0	0	0	0													
Oceania	Regatta_Port	Mixed	UW	07/19/19	GP	AE 23081	2.81	22.9	8.21	0	0	2	2.8	6.4	5.2	1030	0	16									
Oceania	Regatta_Port	Mixed	UW	07/29/19	GP	AE 23084	4.36	22.6	8.02	0	0	0	3.9	6	6.4	1280	0	14									
Oceania	Regatta_Port	Mixed	ST	08/09/19	GP	AE 23292	3.64	27.8	7.52	0	0	0	14	0													
Oceania	Regatta_Port	Mixed	ST	08/10/19	PP	AE 23248	3.60	27	6.85	0	0	5	4.9	0	13	2050	0	7.7	3.9	14	0	41	0	52	4.8	1.71	
Oceania	Regatta_Port	Mixed	ST	08/23/19	GP	AE 23241	2.40	22.4	6.92	0	0	0	2.5	0	11	1810	0	29									
Oceania	Regatta_Port	Mixed	ST	09/01/19	PP	AE 23385	5.40	23.5	7.53	0	0	8.0	5.5	26	0	1140	26	22	15	22	0	43	0	55	0	2.83	
Oceania	Regatta_Stbd	Mixed	ST	05/25/19	GP	AE 22418	2.03	18.8	7.1	0	0	0	3.9	0	55	5520	310	79									
Oceania	Regatta_Stbd	Mixed	ST	06/02/19	PP	AE 22442	1.81	20.7	7.25	0	0	0	11	16	47	2480	110	60	24	25	0	110	2.0	64	6.1	1.56	
Oceania	Regatta_Stbd	Mixed	ST	06/15/19	GP	AE 22637	1.73	22	6.31	0	0	3	38	0	13	3970	71	200									
Oceania	Regatta_Stbd	Mixed	ST	07/12/19	GP	AE 22970	3.20	22.6	7.24	0	0	0	0	0													
Oceania	Regatta_Stbd	Mixed	ST	07/19/19	GP	AE 23085	2.81	24.2	7.36	0	0	0	0	0	6.4	984	41	4.3									
Oceania	Regatta_Stbd	Mixed	ST	07/29/19	GP	AE 23088	4.36	26.3	7.28	0	0	0	2.1	0	14	939	52	5.1									
Oceania	Regatta_Stbd	Mixed	ST	08/09/19	GP	AE 23293	3.64	25.3	7.15	0	0	0	0	0													
Oceania	Regatta_Stbd	Mixed	ST	08/10/19	PP	AE 23249	3.60	24.8	7.26	0	0	0	0	0	3.1	1170	35	9	3.6	9.1	0	37	0	46	0	0	
Oceania	Regatta_Stbd	Mixed	ST	08/23/19	GP	AE 23244	2.46	22	7.3	0	0	0	15	0	17	1490	86	9.3									
Oceania	Regatta_Stbd	Mixed	ST	09/01/19	GP	AE 23386	5.40	23.1	7.65	0	0	0	3.9	24	0	1150	27	20									
RCL	Ovation of the Seas	Mixed	UW	05/17/19	GP	AE 22188	28.96	28.2	7.3	0	0	0	2.4	7.6													
RCL	Ovation of the Seas	Mixed	UW	05/27/19	GP	AE 22420	51.84	30.6	7.38	0	0	0	2.2	7.2													
RCL	Ovation of the Seas	Mixed	UW	06/03/19	PP	AE 22443	42.44	28.5	7.46	0	0	0	2.2	4.4	27	682	51	0.18	0.23	2	0	36	0	0	33	0.354	
RCL	Ovation of the Seas	Mixed	UW	06/17/19	GP	AE 22641	51.00	30.6	7.27	0	0		0	5.6													
RCL	Ovation of the Seas	Mixed	UW	06/24/19	GP	AE 22787	52.14	30.5	7.31	0	0	0															
RCL	Ovation of the Seas	Mixed	UW	07/15/19	GP	AE 22861	54.25	30.3	6.85	0	0	0	2.8	7.2													
RCL	Ovation of the Seas	Mixed	UW	07/22/19	GP	AE 22885	26.77	28.3	7.25	0	0	0	2.2	8.4													
RCL	Ovation of the Seas	Mixed	UW	08/05/19	PP	AE 23002	44.14	30.5	6.61	0	0	0	0	4	1.5	555	50	3.5	2.2	32	0	35	0	3.3	6	1.38	
RCL	Ovation of the Seas	Mixed	UW	08/19/19	GP	AE 23225	26.64	31	6.99	0	0	0	2.3	6.4													
RCL	Ovation of the Seas	Mixed	UW	09/09/19	GP	AE 23409	28.24	28.6	7.2	0	0	0	0	4.8													
RCL	Ovation of the Seas	Mixed	UW	09/16/19	GP	AE 23465	39.41	30.1	7.34	0	0	3.0	0	0													
Seabourn	Sojourn	Mixed	ST	06/12/19	GP	AE 22629 R	11.16	33.56	7.11	0	0	0	7.2	0	27	1100	35	11									
Seabourn	Sojourn	Mixed	ST	06/15/19	GP	AE 22638	10.98	36.2	6.62	0	0	0	4.7	0	29	1100	34	11						0	8.9	30	7.51

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/ NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)
Seabourn	Sojourn	Mixed	ST	07/08/19	GP	AE 22744	10.92	34.8	7.03	0	0	0	0	0	19	1200	56	7.5								
Seabourn	Sojourn	Mixed	ST	07/22/19	GP	AE 22891	16.44	35.7	7.48	0	0	0	7.1	0	40	1180	36	13					0	10	42	1.25
Seabourn	Sojourn	Mixed	ST	08/13/19	GP	AE 23122	12.48	38.1	7.23	0	0	0	0	0	30	1200	33	14								
Seabourn	Sojourn	Mixed	ST	08/28/19	GP	AE 23251	4.85	33.4	6.81	0	0	0	0	0	24	1140	38	17								
Seabourn	Sojourn	Mixed	UW	09/04/19	GP	AE 23397		37.1	7.11	0	0	0	0	0	9.3	858	47	8.4								
Seabourn	Sojourn	Mixed	UW	09/19/19	GP	AE 23475	5.48	33.1	7.01	0	0	0	0	0	22	1270	55	17								
Seabourn	Sojourn	Mixed	UW	10/01/19	GP	AE 23624	7.55	34.7	7.11	0	0	0	0	0	19	1020	34	20					1.0	25	20	1.78
Seven Seas	Mariner	Mixed	UW	05/13/19	GP	AE 22174	9.00	39.3	7.42	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	05/20/19	PP	AE 22341	9.00	38.1	7.18	0	0	0	0	0	0	808	45	5.9	8.2	59	0	60	0	0	0	1.92
Seven Seas	Mariner	Mixed	UW	06/09/19	GP	AE 22612	9.00	38.8	7.34	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	06/22/19	GP	AE 22659	9.00	40.4	7.24	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	07/06/19	GP	AE 22731	9.00	43.9	7.52	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	07/27/19	GP	AE 22898	9.00	41.6	7.28	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	08/04/19	GP	AE 22999	9.00	41.8	6.97	0	0	0	0	0												
Seven Seas	Mariner	Mixed	UW	08/10/19	PP	AE 23102	9.00	42	7.12	0	0	0	2.0	0	0	573	28	4.6	9.4	63	0	44	0	0	3.6	4.35
Seven Seas	Mariner	Mixed	UW	09/01/19	GP	AE 23255	9.00	38.9	6.83	0	0	0	0.0	0												
Seven Seas	Mariner	Mixed	UW	09/15/19	GP	AE 23464	9.00	40.5	7.55	0	0	0	0	0												
Viking	Orion	Mixed	ST	05/30/19	GP	AE 22434	12.00	26.3	6.96	0	0	260	10	9.6	21	1250	70	5.1			21					
Viking	Orion	Mixed	ST	06/11/19	PP	AE 22625	12.00	27.2	6.92	0	0	12	18	8.8	23	1385	110	1.7	15	78	0	100	870	1.8	34	1.54
Viking	Orion	Mixed	ST	06/19/19	GP	AE 22653	11.00	24.4	6.56	0	0	0	10	12	15	7170	300	1.3								
Viking	Orion	Mixed	ST	07/10/19	PP	AE 22755	11.00	28.1	6.55	0	0	0	2.8	5.2	5.9	1210	73	1.3	13	73	0	18	0	5.8	7.7	0.257
Viking	Orion	Mixed	ST	07/21/19	GP	AE 22886	11.50	26.5	6.68	0	0	0	2.6	4.8	7.6	1100	61	0								
Viking	Orion	Mixed	ST	08/10/19	GP	AE 23106	11.00	27	6.62	0	0	0	6.9	4.8	16	1070	79	0								
Viking	Orion	Mixed	ST	08/16/19	GP	AE 23333	11.00	30	6.67	0	0	0	0	4.4	16	1930	130	0								

2019 Greywater Effluent																											
Princess	Golden	GW	ST	05/09/19	GP	AE 22165	10.68	31.8	6.63	0	0	0	0	0	0	260	17	9.5									
Princess	Golden	GW	ST	05/21/19	PP	AE 22352	16.80	30.4	7.18	0	0	0	0	0	14	490	28	12	9.9	170	0	32	0	13	13	1.80	
Princess	Golden	GW	ST	06/12/19	GP	AE 22628	13.32	31.3	5.31	0	0	0	0	0	3.8	421	41	49									
Princess	Golden	GW	ST	06/18/19	GP	AE 22646	14.58	31.3	6.45	0	0	0	0	0	4.9	416	31	9.9									
Princess	Golden	GW	ST	07/10/19	PP	AE 22752	10.38	32.8	7.05	0	0	0	0	0	0	376	43	14	11	98	0	0	0	11	0	0.375	
Princess	Golden	GW	ST	07/16/19	GP	AE 22868	16.80	32.2	7.27	0	0	0	0	0	0	181	21	17									
Princess	Golden	GW	ST	08/07/19	GP	AE 23092	9.36	33.2	7.06	0	0	0	0	0	0	290	32	13									
Princess	Golden	GW	ST	08/21/19	GP	AE 23236	13.80	32.5	7.14	0	0	0	0	0	2.6	409	34	18									
Princess	Golden	GW	ST	09/04/19	GP	AE 23396	12.00	31.1	7.06	0	0	0	0	0	1.6	388	30	14									
Princess	Golden	GW	ST	09/10/19	GP	AE 23415	11.40	32.6	7.60	0	0	0	0	0	25	512	27	2.9									
Princess	Golden	GW	ST	09/19/19	GP	AE 23600	10.58	33.5	6.01	0	0	0	0	0													
Princess	Grand	GW	ST	05/09/19	PP	AE 22166	10.59	27.7	7.18	0	0	0	7.1	0	0	3110	280	0	12	26	0	62	1	0	1.3	0	
Princess	Grand	GW	ST	05/19/19	GP	AE 22337	4.46	25.1	7.35	0	0	0	4.7	0	0.66	4670	400	1.1									
Princess	Grand	GW	ST	06/09/19	GP	AE 22613	7.50	29	7.45	0	0	15	6.1	0	3.9	1610	120	1.2									
Princess	Grand	GW	ST	06/19/19	GP	AE 22651	7.34	25.9	6.91	0	0	0	7.1	0	0	1830	110	0.78									
Princess	Grand	GW	ST	07/10/19	GP	AE 22753	15.74	28.1	6.92	0	0	0	4.0	0	1.0	2880	250	0.89									
Princess	Grand	GW	ST	07/28/19	GP	AE 23133	12.12	26	7.29	0	0	2	6.8	0	0.5	3130	290	0									
Princess	Grand	GW	ST	08/08/19	GP	AE 23098	8.97	27.9	7.08	0	0	0	0	0	0.0	2770	250	0									
Princess	Grand	GW	ST	08/18/19	PP	AE 23224	1.32	27.7	7.49	0	0	0	0	0	0.0	5610	720	0	11	18	0	110	0	0	0	0	
Princess	Grand	GW	ST	09/06/19	GP	AE 23404	14.71	27.0	7.58	0	0	0	0	0	1.8	15400	1600	0									

Company	Vessel	Wastewater Type	Vessel Status [1]	Sample Date	Sample Type [2]	Sample Number	Flow rate (m3/hr)	Temp (C)	pH (S.U.)	Free Cl (mg/L)	Total Cl (mg/L)	Fecal Coliform (FC/100mL)	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	SC (umhos/cm)	Hardness (mg/L)	Dissolved Copper (µg/L)	Dissolved Nickel (µg/L)	Dissolved Zinc (µg/L)	Settleable Solids (mg/L)	COD (mg/L)	E.coli (MPN/100mL)	NO2/ NO3 (mg/L)	Kjeldahl Nitrogen (mg/L)	Phosphorus (µg/L)
Princess	Grand	GW	ST	09/18/19	GP	AE 23472	12.1	25.4	7.06	0	0	0	0	0	0.0	4820	450	1.3								
Princess	Royal	GW	ST	05/14/19	GP	AE 22182		29.5	6.74	0	0	0	0	0	0.92	290	22	5.8								
Princess	Royal	GW	ST	05/22/19	GP	AE 22354	9.49	28.7	6.94	0	0	0	0	0	0	370	35	15								
Princess	Royal	GW	ST	06/05/19	PP	AE 22453	10.71	26.5	7.02	0	0	0	0	0	0	294	35	1.9	11	100	0	0	0	5.5	0	0.239
Princess	Royal	GW	ST	06/11/19	GP	AE 22622	11.48	30.0	6.58	0	0	0	0	0	0	362	38	1.9								
Princess	Royal	GW	ST	07/09/19	GP	AE 22748	12.06	28.4	6.63	0	0	0	0	0	0	298	21	1.7								
Princess	Royal	GW	ST	07/23/19	GP	AE 22892	11.55	31.3	6.38	0	0	0	0	0	0	270	34	3								
Princess	Royal	GW	ST	08/06/19	GP	AE 23010	9.05	31.8	6.86	0	0	0	0	0	0	308	27	2.1								
Princess	Royal	GW	ST	08/28/19	GP	AE 23235	0.14	29.3	7.17	0	0	0	0	0	0	265	23	2.4								
Princess	Royal	GW	ST	09/03/19	PP	AE 23393	15.91	26.3	8.00	0	0	0	14	0	170	1720	50	2.2	13	97	0	96	0	0.70	160	9.80
Princess	Royal	GW	ST	09/11/19	GP	AE 23457	10.81	29.8	7.02	0	0	0	0	0	0	242	25	1.8								
Princess	Ruby	GW	ST	04/28/19	GP	AE 22029	15.06	27.2	7.35	0	0	0	15	0	3.8	309										
Princess	Ruby	GW	ST	05/13/19	PP	AE 22177	10.59	28.2	7.05	0	0	0	2.3	0	4.8	414	29	1.6	7.5	70	0	33	0	0	7.8	2.05
Princess	Ruby	GW	ST	05/20/19	GP	AE 22344	10.34	28.9	6.99	0	0	0	25	0	0	690	56	6.3								
Princess	Ruby	GW	ST	06/03/19	GP	AE 22447	5.00	28.4	7.25	0	0	0	2.7	0		327	17	3.9								
Princess	Ruby	GW	ST	06/10/19	GP	AE 22619	5.00	27.8	7.19	0	0	0	42	0	0	363	20	4.4								
Princess	Ruby	GW	ST	07/01/19	GP	AE 22725	13.08	28.7	7.04	0	0	0	0	0	0	353	11	7.9								
Princess	Ruby	GW	ST	07/08/19	GP	AE 22956	1.8	31.3	6.63	0	0	0	11	0												
Princess	Ruby	GW	ST	07/22/19	PP	AE 22890	12.20	30.9	7.23	0	0	0	10	0	0	675	28	9.5	13	140	0	85	3.0	0.17	0	0
Princess	Ruby	GW	ST	08/12/19	GP	AE 23114	3.96	31.1	7.32	0	0	0	6.8	0	0	674	31	7.8								
Princess	Ruby	GW	ST	08/19/19	GP	AE 23228	6.78	29.4	7.32	0	0	0	0	0	0	909	53	8.8								
Princess	Ruby	GW	ST	09/02/19	GP	AE 23390	99	30.2	7.04	0	0	0	8.9	0	0	437	18	4.8								
Princess	Ruby	GW	ST	09/09/19	GP	AE 23412	76.62	28.6	7.07	0	0	0	2.1	0	1.5	235	5.6	4.8								
Princess	Star	GW	ST	05/02/19	GP	AE 22151	17.76	32.9	6.75	0	0	0	3.8	0	3.5	1000	74	0.69								
Princess	Star	GW	ST	05/15/19	PP	AE 22185	20.55	36.3	7.10	0	0	0	0	0	1.2	553	32	0	7.6	50	0	26	0	0	1.6	0
Princess	Star	GW	ST	06/05/19	GP	AE 22454	19.82	34.9	6.76	0	0	0	29	0	3.3	872	70	0.58								
Princess	Star	GW	ST	06/12/19	GP	AE 22632	5.85	35.2	6.76	0	0	0	16	0	1.2	390	35	0.69								
Princess	Star	GW	ST	07/17/19	GP	AE 22874	21.96	33.8	6.57	0	0	0	3.4	0	0.77	286	19	0								
Princess	Star	GW	ST	07/24/19	GP	AE 22896	18.00	32.2	6.91	0	0	0	7.3	0	0.94	552	36	0								
Princess	Star	GW	UW	07/31/19	GP	AE 23131	25.89	33	6.82	0	0	0														
Princess	Star	GW	ST	08/14/19	GP	AE 23127	20.46	34.5	6.79	0	0	0	6.8	0	0.82	319					0	50	0	0		
Princess	Star	GW	ST	08/21/19	GP	AE 23238	20.55	32.9	6.73	0	0	0	8.2	0	0.78	288	15	0								
Princess	Star	GW	ST	09/04/19	GP	AE 23399	19.32	33.6	6.7	0	0	0	3.7	0	0.63	248	16	0								
Princess	Star	GW	ST	09/11/19	GP	AE 23461	27.89	34.1	6.95	0	0	0	4.3	0	0	328	17	0								

[1] UW: Underway (> 6 knots), ST: Stationary

[2] GP: General Permit, Twice Monthly Sample; PP: Priority pollutants (full suite).

Parameter Result Exceeds Daily Maximum in Large Cruise Ship GP.

Exceedance of both Daily & Monthly GP Limits for Parameter.

Parameters not tested or failed Quality Assurance (e.g. holding time not met).

"value"

Outlier flow rates from lab field data (i.e. determined by using 1.5x Quartile Range method), not used for Summary Statistics.