

# 2019 Small Cruise Ship and Ferry Wastewater Report

COMMERCIAL PASSENGER VESSEL ENVIRONMENTAL  
COMPLIANCE (CPVEC) PROGRAM



November 2019



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)
SCPV	Small Commercial Passenger Vessel
TSS	Total Suspended Solids (sampled parameter)
VSSP	Vessel Specific Sampling Plan

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## INTRODUCTION

This report summarizes 2019 wastewater sampling results for small cruise ships<sup>1</sup> and Alaska Marine Highway Ferry System vessels (AMHS) discharging in Alaska waters<sup>2</sup>. Appendix A provides vessel information and Appendix B provides wastewater sampling results.

This year 19 small commercial passenger vessels (SCPVs) registered with ADEC and 17 of those (14 SCPVs and 3 AMHS) intended to discharge to AK waters (Table A1). Discharging SCPVs are required to sample once during the season and AMHS vessels sample every 3 months of operation (4 samples total, assuming year round operation). Sampling is necessary to:

- Verify that Marine Sanitation Devices (MSD) onboard are achieving good effluent quality in accordance with their BMP Plans;
- Document treatment system performance for future BMP Planning; and
- Gather information on potential environmental impacts from smaller commercial vessels operating in AK waters.

Alaska law (AS 46.03.463) puts discharge limits Fecal Coliform (FC) and Total Suspended Solids (TSS). If an exceedance of FC or TSS occurs the vessels Best Management Plan (BMP) directs them to take corrective action, report to ADEC, and resample to confirm compliance. To insure quality data is obtained, each vessel must have a Vessel Specific Sampling Plan (VSSP) and Quality Assurance Project Plan (QAPP), approved by ADEC. Deadlines for these and other required documents are listed in Table A2.

Reports and summaries for prior years can be found on the cruise program's report webpage (<https://dec.alaska.gov/water/cruise-ships/cruise-reports/>)

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<sup>1</sup> SCPVs have overnight accommodations (lower berths) for 50 to 249 passengers.

<sup>2</sup> Alaska water extends 3 miles from the coastline and includes the Alexander Archipelago.

## **BACKGROUND**

Commercial passenger ships produce two types of wastewater: blackwater and graywater. Blackwater is wastewater from ship's toilets and medical facilities. Graywater is water from accommodations (showers/sinks), galley areas, and laundry. Any combination of blackwater and graywater will be referred to as mixed wastewater in this report, but technically it is considered blackwater.

Marine Sanitation Devices (MSD) are required for the discharge of treated blackwater and must meet performance requirements<sup>3</sup> for US Coast Guard approval of Type II MSD systems for vessels operating in US waters. AMHS and many small cruise ships process graywater through their MSD, although due to limited holding capacity, some discharge untreated graywater directly overboard. Advanced Wastewater Treatment Systems found in larger cruise ships are not feasible on small ships due to physical constraints (stability/space), economic feasibility, or both. These limitations led the State of Alaska implemented a Best Management Practices (BMP) program for small vessels (>250 overnight accommodations).

Regulations require the BMP to include certain elements, such as inclusion of no discharge areas, (18 AAC 69.046 (c)). Though not in regulation, the Department has begun working with operators to avoid discharges in the Port of Ketchikan. The National Park Service prohibits discharge in several federally managed areas of concern, such as Glacier Bay Park and Preserve.

## **REQUIREMENTS**

Small cruise ships may not discharge sewage from a small commercial passenger vessel unless the sewage has been processed through a properly operated and maintained marine sanitation device (AS 46.03.463)<sup>4</sup>. Small cruise ships and ferries are required to meet standard terms and conditions, or seek alternative terms and conditions with BMP plans, in order to discharge wastewater in Alaska marine waters. Alaska State Statutes allowing alternative terms and conditions were updated in 2017. Subsequently, Regulations were updated and multiple ships modified their BMPs in 2018.

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<sup>3</sup> Performance is measured under controlled test conditions.

<sup>4</sup> Determination of a properly maintained MSD is described 18 AAC 69.080.

Standard terms and conditions for treated blackwater, graywater, and other wastewater (AS 46.03.463, Prohibited discharges; limitations on discharges) align with the USCG limits for approved Type II MSDs, 33 CFR 159.53(b). Wastewater must contain no more than 200 FC per 100 milliliters and no more than 150 milligrams per liter of TSS. Traditionally blackwater has had the highest median fecal coliform results, although very high results have also been found in graywater. Ships with separate graywater discharges were allowed to sample graywater for conventional parameters every other year starting in 2016.

## **METHODS**

Wastewater sampling consists of grab samples taken from the MSD overboard pipe (described in the VSSP) while the vessel is discharging. The VSSP also described appropriate sampling times, to insure samples are representative of wastewater discharges into Alaska waters. Sampling follows the requirements in the vessels approved QAPP. In 2019, 4 cruise lines and the AMHS (15 vessels) used their own Department approved QAPP, while 2 cruise lines (2 vessels) used the 2019 Cruise Line International Association (CLIA) Alaska Wastewater QAPP, developed for Large Cruise ships (Table A3). The QAPP specifies minimum requirements for collection and analysis of wastewater samples. It includes a list of approved methods, data quality objectives, and responsibilities of the parties that approve the document.

Sampling may occur while underway or while docked (stationary). Typically Admiralty Environmental sampled while in port, while underway sampling in route to Juneau was typical for vessel conducting their own wastewater sampling. All samples in this report were taken in Southeast Alaska in 2019, with the majority of samples obtained in or near Juneau, in order to meet sample holding times requirements in the QAPP.

Laboratory analysis was conducted locally by Admiralty Environmental, with some samples being shipped to the lower 48 for analysis by a subcontractor (Microbac Laboratories, Inc). Some vessels receive training from Admiralty at the beginning of the season and take samples themselves, while others opt to have Admiralty collect samples onboard (Table A3). The cruise ship program reviews results submitted by the cruise ship operators for compliance with the QAPP and VSSPs.

## RESULTS

Table 1 and 2 provide summary data for effluent parameters measured. 2019 wastewater sampling results are listed in Appendix B. Results for conventional parameters are separated into three tables, based on the wastewater type sampled: Table B1 is BW only samples; Table B2 is GW only samples; and Table B3 is mixed wastewater samples (BW+GW). Non-detect (ND) values are entered as zeros<sup>5</sup> and summary statistics are biased low (Helsel 1990).

**Table 1. 2019 Small Cruise Ship & Ferry Summary Data, Mixed WW Effluent**

Analyte	Units	n (count)	Minimum <sup>1</sup>	Maximum	Median	Average
<b>Temp</b>	°C	25	9.9	32.0	17.0	19.0
<b>pH</b>	SU	25	6.47	9.21	7.40	7.45
<b>Free Chlorine</b>	mg/L	24	<0.10	13	0	1
<b>Total Chlorine</b>	mg/L	24	<0.10	50	0	4
<b>Fecal Coliform Bacteria</b>	FC/100ml	25	<2.0	3,500,000	18	321,805
<b>Total Suspended Solids</b>	mg/L	25	<4.0	424	93	105
<b>Biochemical O<sub>2</sub> Demand</b>	mg/L	25	<2.0	990	140	245
<b>Ammonia (as N)</b>	mg/L	10	<2.5	140	38	43.13
<b>Chemical Oxygen Demand</b>	mg/L	10	290	1,500	837	880
<b>Specific Conductance</b>	umhos/cm	10	1,230	46,400	35,750	23,940
<b>Oil &amp; Grease</b>	mg/L	10	<5.0	81.1	4.5	12.0
<b>Alkalinity (Total)</b>	mg/L	10	100	700	225	281
<b>Hardness (as CaCO<sub>3</sub>)</b>	mg/L	10	28	4,400	1,780	2,015
<b>Total Settleable Solids</b>	ml/L	8	<0.1	18	0.00	2.31
<b>Total Organic Carbon</b>	mg/L	6	<0.50	220	6	55
<b>Nitrate-Nitrite (as N)</b>	mg/L	6	<1.0	0.18	0.00	0.05
<b>Total Kjeldahl Nitrogen</b>	mg/L	6	<0.50	220	44	67
<b>Total Phosphorus</b>	mg/L	6	<0.20	17	2	5

<sup>1</sup> Below Lab Reading Level

<sup>5</sup> To be consistent with large cruise ship data, requiring calculation of geometric means. Metal non-detects are still reported as NDs

**Table 2. 2019 Small Cruise Ship & Ferry Summary Data, GW Effluent**

Analyte	Units	n (count)	Minimum <sup>1</sup>	Maximum	Median	Average
<b>Temp</b>	°C	7	16.2	29.7	18.6	21.2
<b>pH</b>	SU	7	4.29	9.2	7.01	7.05
<b>Free Chlorine</b>	mg/L	7	<0.10	1.02	0.00	0.25
<b>Total Chlorine</b>	mg/L	7	<0.10	8.20	0.15	1.54
<b>Fecal Coliform Bacteria</b>	FC/100ml	7	0.00	520,000	310	80,801
<b>Total Suspended Solids</b>	mg/L	7	12	117	45	59
<b>Biochemical O<sub>2</sub> Demand</b>	mg/L	7	310	1,100	680	640

<sup>1</sup> Below Lab Reading Level

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. Table B4 provides metals sampling results.

## EXCEEDANCES

Table 3 provides an Exceedance summary for discharging vessels sampled in 2019. The majority of MSD systems on small vessels incorporate chlorination into the treatment process. Chlorine is sampled, however resampling is not required unless FC or TSS is exceeded.

Looking only at Mixed Wastewater results; 11 vessels were sampled during 26 sampling events in 2019 (Table 4). Six vessels were able to resample as a result of high Fecal Coliform (FC); 4 exceeded the FC limit a second time and two improved performance of their MSD to meet standards. All vessels resampled for a TSS exceedance were able to meet standards during the resampling event. See Table B3 for sampling results. Table 4 also provides 2018 exceedances of FC/TSS for comparison.



**Table 3. 2019 Exceedance Summary for by Vessels**

Vessel Name	WW Type	Samples Taken (Total)	2019 Exceedances (count)			VESSEL Resampled (Y/N/NR)	Comments following Resample
			Fecal Coliform (>200FC /100ml)	Total Suspended Solids (>150 mg/L)	Total Chlorine <sup>1</sup> (>1 mg/L)		
Columbia	MIX	2	0	0	0	Not Required	
Kennicott	MIX	3	1	0	1	Yes	Corrected, all parameters under limits
Malaspina	MIX	2	0	0	2	Not Required	
Chichagof Dream	MIX	2	2	0	1	Yes	Fecal improved, but still over limit.
American Constellation	MIX	2	2	0	0	Yes	Fecal 10x higher during resample.
NG Quest	MIX	2	0	0	0	Not Required	
NG Venture	MIX	3	2	1	1	Yes (x2)	Higher Fecal and TSS during final resample
Star Legend	MIX	4	1	0	0	Yes (x3)	Slightly elevated Fecal, below limits for last sample
Wilderness Adventurer	MIX	1	0	1	1	No	
Wilderness Discoverer	MIX	1	0	0	1	No	
Wilderness Explorer	MIX	3	2	1	1	Yes (x2)	Fecal under limits, however Total Chlorine jumped to 50mg/L
Safari Endeavour	BW	1	0	0	0	Not Required	
SS Legacy	BW	1	0	0	1	Not Required	
Admiralty Dream	GW	1	1	0	0	No	
Safari Endeavour	GW	1	1	0	0	No	
NG Sea Bird	GW	2	1	0	1	Yes	Fecal under limits, higher Total
NG Sea Lion	GW	1	0	0	1	Not Required	
Star Legend	GW	2	1	0	0	Yes	Corrected, Fecal under limits.
Totals		34	14	3	11		
Percent of Samples			41%	9%	32%		

<sup>1</sup> Resampling is not required for Total Chlorine exceedances.**Table 4. 2019/2018 Comparison Mixed Effluent, Vessel Count**

VESSELS (n=Individual Vessels)	2019 (n=11)	Percentage	2018 (n=9)	Percentage
Vessels with FC Exceedance (>200 FC/100mL)	7	64%	4	44%
Vessels with second FC Exceedance <sup>1</sup> [Resampled vessels; 2019 (n=6), 2018 (n=4)]	4	67%	2	50%
Vessels with TSS Exceedance (>150 mg/L)	3	27%	3	33%

<sup>1</sup> Not all vessels with Exceedances were resampled.

## CONCLUSION

In 2019, 41% of samples had FC exceedances (14 exceedances out of 34 total samples). The majority of resamples resulted in a second FC exceedance. The CPVEC program will continue to work with small cruise ships and AMHS to improve overall wastewater effluent quality. Small cruise ships and state ferries continue to balance bacterial digestion processes with chlorine disinfection. Chlorine is used to sterilize effluent, but it is toxic to marine organisms and high residuals must be avoided. Several vessels have installed equipment to dechlorinate the treated wastewater.

Since the beginning of the CPVEC program and implementation of the small cruise ship BMPs several vessels have shown improvements and more consistent performance of their MSD units. Unfortunately, some ships continue to exceed standards for fecal coliform, chlorine, and BOD. In 2019, two major issues were identified that warrant greater oversight in 2020:

- 1) Chlorine levels: Multiple vessels had FC exceedances that resulted from problems with insufficient chlorine levels. By correcting mechanical problems or increasing dosage they were able to decrease FC levels, however 1/3 of mixed water samples contained elevated chlorine levels; TRC ranging between 1.10 and 50 mg/L (see Table B3 in Appendix B), while AKWQS are exceeded at 0.10 mg/L.

Raising the chlorine dosage is a short term fix and vessels will need to work within their ADEC approved BMP plans to diagnose and conduct corrective actions in order to improve overall effluent quality entering AK waters.

- 2) Preliminary Lab Results: There were issues with timely identification of elevated fecal results. Vessels should engage with their lab provider to obtain preliminary results in order to quickly diagnose and correct problems (e.g. high FC counts) in a timely manner.

## 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/>

Small Cruise Ship Discharge Options

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

Alaska Cruise Ship Laws and Regulations

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

2019 CLIA Wastewater Sampling Quality Assurance Project Plan

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

Sample reports and summaries from other years

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

## APPENDIX A: SMALL PASSENGER VESSEL INFORMATION

**Table A1: 2019 Wastewater Treatment and Discharges from SCPVs<sup>1</sup> in AK Waters**

									Discharging in Alaska <sup>4</sup> & Subject to sampling program		
	Vessel Operator	Vessel Name	Passenger Capacity <sup>2</sup>	Crew Capacity	Voyages	Maximum Total Passengers <sup>3</sup>	Blackwater Treatment System Manufacturer	Units	BMP	BW	GW
1	Alaska Marine Highway	<i>Columbia</i>	625	66	See AMHS schedules	N/A	Omnipure 15MX	4	Yes	Yes- Mixed	
2	Alaska Marine Highway	<i>Kennicott</i>	748	42		N/A	Orca II 500	3	Yes	Yes-Mixed	
3	Alaska Marine Highway	<i>Malaspina</i>	500	50		N/A	Omnipure 15MX	3	Yes	Yes-Mixed	
4	Alaska Dream Cruises	<i>Admiralty Dream</i>	66	21	18	1188	Omnipure 12M	1	Yes	Yes	Yes
5	Alaska Dream Cruises	<i>Chichagof Dream</i>	81	27	18	1458	Orca II A-500 MSD	1	Yes	Yes- Mixed	
6	American Cruise Lines	<i>American Constellation</i>	173	46	13	2249	Marine Fast MSD	1	Yes	Yes- Mixed	
7	Hapag-Lloyd	<i>Bremen</i> <sup>5</sup>	155	94	1	155	Hamworthy RT 80	1	No	No	No
8	Lindblad/Nat. Geographic	<i>National Geographic Orion</i>	102	69	6	612	Triton Format STP	1	No	No	No
9	Lindblad/Nat. Geographic	<i>National Geographic Quest</i>	106	50	16	1696	Gertsen & Olufsen Bioreactor	1	Yes	Yes-Mixed	
10	Lindblad/Nat. Geographic	<i>National Geographic Sea Bird</i>	62	28	18	1116	Omnipure 12MX	1	Yes	Yes	Yes
11	Lindblad/Nat. Geographic	<i>National Geographic Sea Lion</i>	62	28	16	992	Omnipure 12M	1	Yes	Yes	Yes
12	Lindblad/Nat. Geographic	<i>National Geographic Venture</i>	108	50	18	1944	Gertsen & Olufsen Bioreactor	1	Yes	Yes-Mixed	
13	Silver Expeditions	<i>Silver Explorer</i>	144	130	5	720	AquaMaster Unex Bio 200 E	1	Yes	Yes- Mixed	
14	Un-Cruise Adventures	<i>Safari Endeavor</i>	86	35	17	1462	Omnipure 12M5508	2	Yes	Yes	Yes
15	Un-Cruise Adventures	<i>S.S. Legacy</i>	92	34	15	1380	Red Fox RF-2000-FP	1	Yes	Yes	Yes
16	Un-Cruise Adventures	<i>Wilderness Adventurer</i>	64	23	24	1536	Omnipure 12MX	1	Yes	Yes-Mixed	
17	Un-Cruise Adventures	<i>Wilderness Discoverer</i>	75	24	18	1350	Omnipure 12MX	1	Yes	Yes-Mixed	
18	Un-Cruise Adventures	<i>Wilderness Explorer</i>	76	26	19	1444	Red Fox RF-2000-FP	1	Yes	Yes	Yes
19	Windstar	<i>Star Legend</i>	212	155	12	2544	Rochem Biofiltration 18/27-10	1	Yes	Yes- Mixed	
Vessels highlighted in gray registered for no discharge into AK waters				Totals	234	21,846					

<sup>1</sup>Small Commercial Passenger Vessels (SCPVs) have overnight accommodations for 50 to 249 passengers based on lower berths.

<sup>2</sup>Based on lower berths for small cruise ships and capacity for ferries.

<sup>3</sup>Estimate based on 2019 Registration.

<sup>4</sup>Alaska water extends 3 miles from the coastline and includes the Alexander Archipelago.

<sup>5</sup>The *Bremen* was scheduled for one voyage to Nome and Bethel in Northeast AK.

**Table A2: 2019 Requirements and Deadlines for Small Commercial Passenger**

<b>Document</b>	<b>Authority</b>	<b>Due Date</b>
<b>PRE-SEASON Requirements:</b>		
REGISTRATION & Notarized Signature Page	AS 46.03.461, 18 AAC 69.010	Friday, March 1, 2019
Non-hazardous Solid Waste Offloading and Disposal Plan	AS 46.03.475(e)(1), 18 AAC 69.035	Friday, March 1, 2019
Hazardous Waste and Substance Offloading Plan	AS 46.03.475(e)(2), 18 AAC 69.040	Friday, March 1, 2019
<b>Requirements if Discharging IN ALASKAN WATERS:</b>		
Quality Assurance Project Plan (QAPP)	AS 46.03.465(b), 18 AAC 69.025	March 1, 2019 if not already operating under a valid approved and current QAPP.
Best Management Practices(BMP) Plan <b>[1]</b> (if vessel will discharge under alternative terms and conditions)	AS 46.03.462(k)	March 1, 2019 if a current approved plan is not already in place and remains active until the end of the season.
Vessel Specific Sampling Plan (VSSP)	18 AAC 69.030, AS46.03.465 (b)	A 2019 VSSP is required 21 days before sampling.
Wastewater Sampling - LAB RESULTS	18 AAC 69.055	21 days after analytical testing is complete
<b>OTHER Requirements:</b>		
MSD Documentation (Maintenance, Daily Logs), Discharge Logs, other documents required to be maintained onboard (Described in Vessel BMP)	18 AAC 69.045	Upon Request from ADEC-CPVEC
Voyage Report and Deviation Report to document any	18 AAC 69.015, 18 AAC 69.065	Friday, November 15, 2019

**[1]** If a BMP is not submitted, a permit to discharge is needed which meets the terms and conditions of Alaska statute 46.03.462(b).

**Table A3: 2019 ADEC Approved QAPPs for Small Commercial Passenger Vessels**

<b>Vessel Operator</b>	<b>Vessel Name</b>	<b>Quality Assurance Project Plan (QAPP)</b>	<b>Field Parameters Measured by: [1]</b>
Alaska Marine Highway	<i>Columbia</i>	AMHS DOT/PF Small Commercial Passenger Vessel QAPP for Sampling and Analysis of Treated Sewage and Graywater, dated February 18, 2018	Admiralty Environmental
	<i>Kennicott</i>		
	<i>Malaspina</i>		
Alaska Dream Cruises	<i>Admiralty Dream</i>	Alaska Catamaran LLC Generic Small Commercial Passenger Vessel QAPP for Sampling and Analysis of Treated Sewage and Graywater, April 27, 2016	Vessel crew
	<i>Chichagof Dream</i>		
American Cruise Lines	<i>American Constellation</i>	CLIA Alaska Quality Assurance Project Plan for Sampling and Analysis of Treated Sewage and Graywater from Commercial Passenger Vessels (QAPP), dated May 1, 2019.	Admiralty Environmental
Lindblad/Nat. Geographic	<i>National Geographic Quest</i>	Lindblad Expedition's Tier II Quality Assurance Project Plan for Sampling and Analysis of Treated Sewage and Graywater from Commercial Passenger Vessels (QA/QCP), dated May 15, 2015	Vessel crew
	<i>National Geographic Sea Bird</i>		
	<i>National Geographic Sea Lion</i>		
	<i>National Geographic Venture</i>		
Silver Expeditions	<i>Silver Explorer</i>	CLIA Alaska Quality Assurance Project Plan or Sampling and Analysis of Treated Sewage and Graywater from Commercial Passenger Vessels (QAPP), dated May 1, 2019	Admiralty Environmental
Un-Cruise Adventures	<i>Safari Endeavor</i>	Un-Cruise Adventures Small Commercial Passenger Vessel QAPP for Sampling and Analysis of Treated Sewage and Graywater, dated February 21, 2017	Admiralty Environmental
	<i>S.S. Legacy</i>		
	<i>Wilderness Adventurer</i>		
	<i>Wilderness Discoverer</i>		
	<i>Wilderness Explorer</i>		
Windstar	<i>Star Legend</i>	Windstar Cruises M/Y Star Legend QAPP for Sampling and Analysis of Treated Sewage and Graywater from a Commercial Passenger Vessel, dated January, 2018.	Admiralty Environmental

[1] All analytes other than field parameters were processed by Admiralty Environmental or one of their designated subcontractor labs.

APPENDIX B: WASTEWATER RESULTS

Table B1. 2019 Blackwater Sampling: Small Cruise Ship and AMHS Vessels

Analyte <sup>1, 2</sup>				Field				Convention I			Convention II						
				Temp	pH	Free Chlorine	Total Chlorine	Fecal Coliform Bacteria	Total Suspended Solids	Biochemical O <sub>2</sub> Demand	Ammonia (as N)	Chemical Oxygen Demand	Specific Conductance	Oil & Grease	Alkalinity (Total)	Hardness (as CaCO3)	Total Settleable Solids
Units			Sample IP/UW (InPort/Underway)	°C	SU	mg/L	mg/L	FC/100ml	mg/L	mg/L	mg/L	mg/L	umhos/cm	mg/L	mg/L	mg/L	ml/L
Alaska Marine Water Quality Standards, AS 46.03.463, or Secondary Treatment Standard.				N/A	6.5-8.5	N/A	0.0075	200	150	60	1	N/A	N/A	N/A	N/A	N/A	N/A
Vessel Name	Date	Sample #															
Safari Endeavour	5/26/19	AE 22421	IP	10.5	7.70	0	0	18	34	15	5.90	470	35,500	2.5	110.0	5,400	0
SS Legacy	5/3/19	AE 22154	IP	13.5	7.75	0.82	11	790	46	150							
Silver Explorer <sup>3</sup>	7/18/19	AE 22740	IP	23.4	8.22	0.31	13	0	46	110	140	390	3,620		600	150	0
<sup>1</sup> Parameter not Analyzed or "No Data"																	
<sup>2</sup> Exceeds standards. BMP requires corrective action and resample for FC & TSS exceedances																	
<sup>3</sup> Not Discharging or Collection/Holding Tank																	

Table B2. 2019 Graywater Sampling: Small Cruise Ship and AMHS Vessels

Analyte <sup>1, 2</sup>				Field				Convention I				Convention II					
				Temp	pH	Free Chlorine	Total Chlorine	Fecal Coliform Bacteria	Total Suspended Solids	Biochemic al O <sub>2</sub> Demand	Ammonia (as N)	Chemical Oxygen Demand	Specific Conductance	Oil & Grease	Alkalinity (Total)	Hardness (as CaCO3)	Total Settleable Solids
Units			Sample IP/UW (InPort/ Underway)	°C	SU	mg/L	mg/L	FC/100ml	mg/L	mg/L	mg/L	mg/L	umhos/cm	mg/L	mg/L	mg/L	ml/L
Alaska Marine Water Quality Standards, AS 46.03.463, or Secondary Treatment Standard.				N/A	6.5-8.5	N/A	0.0075	200	150	60	1	N/A	N/A	N/A	N/A	N/A	N/A
Vessel Name	Date	Sample #															
Admiralty Dream	6/21/19	AE 22666	UW	16.8	8.26	1.02	0.98	310	45	680							
Safari Endeavour	5/26/19	AE 22422	IP	21.9	7.49	0	0	6,300	117	1,100							
NG Sea Bird	6/9/19	AE 22512	UW	17.7	6.37	0	0.15	520,000	12.0	310							
NG Sea Bird	7/9/19	AE 22712	UW	16.2	9.20	0.40	8.2	0	13	850							
NG Sea Lion	6/8/19	AE 22415	UW	18.6	4.29	0.34	1.47	0	34	400							
Star Legend	5/28/19	AE 22429	IP	29.7	6.73	0	0	39,000	100	830							
Star Legend	6/8/19	AE 22663	IP	27.3	7.01	0	0	0	95	310							
Silver Explorer <sup>3</sup>	7/18/19	AE 22742	IP	23.0	7.79	0.57	4.60	360	113	230	0.89	410	666	122	26	24	0
Star Legend <sup>4</sup>	8/2/19	AE 22979	IP	16.9	6.46	0	0	490,000	131	640							
Star Legend <sup>4</sup>	8/24/19	AE 23451	IP	13.2	6.62	0	0	3,700	47	58							
Star Legend <sup>4</sup>	9/6/19	AE 23511	IP	17.9	7.10	9.00	14	0	82	470							

<sup>1</sup> Parameter not Analyzed or 'No Data'

<sup>2</sup> Exceeds standards. BMP requires corrective action and resample for FC & TSS exceedances

<sup>3</sup> Not Discharging or Collection/Holding Tank

<sup>4</sup> Samples taken from a tank dip sample, and not from a discharge line.



**Table B3. 2019 Mixed Wastewater (BW + GW) Sampling: Small Cruise Ship and AMHS Vessels**

Analyte <sup>1, 2</sup>				Field				Convention I			Convention II							Nutrients			
				Temp	pH	Free Cl	Total Cl	Fecal Coliform	TSS	BOD	Ammonia (as N)	COD	S.Condu ctance	Oil & Grease	Alkalinity (Total)	Hardness (CaCO3)	Settleable Solids	TOC	Nitrate-Nitrite	Kjeldahl Nitrogen	Phosphorus
Units				°C	SU	mg/L	mg/L	FC/100ml	mg/L	mg/L	mg/L	mg/L	umhos/c	mg/L	mg/L	mg/L	ml/L	mg/L	mg/L	mg/L	mg/L
Alaska Marine Water Quality Standards, AS 46.03.463, or Secondary Treatment Standard.				N/A	6.5-8.5	N/A	0.008	200	150	60	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vessel Name	Date	Sample #	IP/UW (InPort/ Underway)																		
Columbia	4/16/19	AE 22021	IP	13.5	6.92	0	0	2.0	30	83	7.30	620	38,600	9.1	120.0	4,400	0	2.3	0.120	7.6	0.826
Columbia	6/17/19	AE 22642	IP	14.9	6.53	0	0	18	20	23											
Kennicott	4/17/19	AE 22022	IP	9.9	7.95	1.41	1.57	5.0	8.4	0	0	840	46,400	0	100	260	0	0.00	0	0.00	0
Kennicott	7/24/19	AE 22893	IP	20.7	7.20	0	0	2,100,000	424	240											
Kennicott	8/27/19	AE 23315	IP	15.6	7.86	0.70	0.80	72	6	8.5											
Malaspina	4/25/19	AE 22026	IP	16.2	6.71	3.10	5.80	0	57	110	14	834	37,600	10.9	130	3,500	0	3	0.18	19.0	0.385
Malaspina	8/25/19	AE 23314	IP	19.3	7.55	1.30	5.40	0	93	70											
Chichagof Dream	6/30/19	AE 22721	UW	16.5	7.80		1.10	360,000	100	54											
Chichagof Dream	8/11/19	AE 23055	UW	16.8	8.20	0.39		150,000	50	37											
American Constellation	7/13/19	AE 22971	IP	25.4	7.58	0	0	3,400	53	150											
American Constellation	8/24/19	AE 23247	IP	24.4	7.24	0	0	3,500,000	142	240	64	880	1,580	0	450	82	0				
NG Quest	6/15/19	AE 22546	UW	17.0	6.96	0	0	0	140	680											
NG Quest	7/13/19	AE 22762	UW	19.4	7.64	0	0.40	0	122	560	140	1,200	2,590	0	700	130	0.5	9	0.0	220	17.0
NG Venture	6/9/19	AE 22416	UW	13.8	6.5	0	0	21,000	130	990											
NG Venture	6/23/19	AE 22713	UW	15.2	7.48	1.19	2.60	0	130	800											
NG Venture	7/7/19	AE 22743	UW	19.0	6.8	0	0	280,000	258	720	59	1,100	1,300	81.1	350	53	18	220	0.00	88	10.9
Star Legend	5/28/19	AE 22428	IP	28.5	7.37	0	0	3.0	10	160	59	290	1,230	0	350	28	0	95.0	0.00	68	3.280
Star Legend	6/8/19	AE 22664	IP	28.2	7.17	0	0	0.0	0.0	160											
Star Legend	7/9/19	AE 22914	IP	32.0	7.40	0	0	600	8.4	120											
Star Legend	7/26/19	AE 23062	IP	31.4	7.25	0	0	0	6.0	150											
Wilderness Adventurer	4/27/19	AE 22028	IP	18.0	7.37	0.88	36	27	327	330	23	1,500	38,100	9.5	200	3,300					
Wilderness Discoverer	5/4/19	AE 22156	IP	11.3	9.21	5.50	2.50	0	116	75	53	820	38,100	8.9	250	4,200					
Wilderness Explorer	6/8/19	AE 22024	IP	13.5	7.85	0	0	1,000,000	54	73	12	720	33900	0	160	4200	0				
Wilderness Explorer	7/20/19	AE 23061	IP	13.9	7.83	0	0.20	630,000	96	140											
Wilderness Explorer	7/27/19	AE 23151	IP	19.6	7.83	13	50	0	252	140											
Star Legend <sup>3</sup>	8/17/19	AE 23377	IP	31.8	7.47	0	0	5.0	0	18											

<sup>1</sup> Not Analyzed or "No Data"<sup>2</sup> Exceeds standards. BMP requires corrective action and resample for FC & TSS exceedances<sup>3</sup> Not Discharging or Holding Tank Sample

Table B4. 2019 Metals Results: Small Cruise Ship and AMHS Vessels

			DISSOLVED [1]								TOTAL [1]									
			Antimony (DISS)	Arsenic (DISS)	Chromium (DISS)	Copper (DISS)	Lead (DISS)	Nickel (DISS)	Selenium (DISS)	Zinc (DISS)	Antimony (TR)	Arsenic (TR)	Chromium (TR)	Copper (TR)	Lead (TR)	Nickel (TR)	Selenium (TR)	Zinc (TR)	Mercury (Total)	
Units			µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg		
Alaska Marine Water Quality Standards (chronic for marine life)			N/A	36	50 (chromium IV)	3.1	8.1	8.2	71	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94		
Vessel Name	Date	WW Type																		
Columbia	4/16/19	Mixed	ND	ND	ND	22	ND	ND	ND	81	ND	ND	ND	17	ND	ND	ND	79	ND	
Kennicott	4/17/19	Mixed	ND	ND	ND	57	ND	ND	ND	65	ND	ND	ND	92	ND	ND	ND	88	ND	
Malaspina	4/25/19	Mixed	ND	ND	ND	53	ND	ND	ND	53	ND	ND	ND	58	ND	ND	ND	31	ND	
American Constellation	8/24/19	Mixed	1.8	3.7	1.5	29	ND	8.0	ND	62	ND	4.4	2.0	99	ND	5.4	1.2	130	ND	
Safari Endeavor	5/26/19	BW	ND	ND	ND	ND	ND	ND	ND	56	ND	ND	ND	45	15	58	ND	260	ND	
NG Quest	7/13/19	Mixed	ND	2.5	1.1	48	ND	4.5	ND	110	ND	2.8	2.1	280	1.4	5.3	1.8	260	ND	
NG Venture	7/7/19	Mixed	1.1	1.1	1.6	38	ND	5.0	ND	120	ND	1.3	ND	80	2.9	6.4	ND	360	ND	
Star Legend	5/28/19	Mixed	ND	1.2	1.7	2	ND	7.4	ND	8.5	ND	1.0	1.3	ND	ND	7.2	ND	12	ND	
Wilderness Adventurer	4/27/19	Mixed	ND	ND	ND	45	ND	ND	ND	66	ND	ND	ND	75	ND	ND	ND	190	0.24	
Wilderness Discoverer	5/4/19	Mixed	ND	ND	ND	90	ND	ND	ND	160	ND	ND	ND	84	ND	ND	ND	160	ND	
Wilderness Explorer	6/8/19	Mixed	ND	ND	ND	40	ND	ND	ND	84	ND	ND	ND	ND	ND	ND	ND	ND	ND	

[1] ND=non-detect. **Note:** Lab analysis conducted for: Beryllium, Cadmium, Silver, and Thallium. All results were non-detects so these metals were omitted from the table.

2019 Summary Data:	n (count)	2	4	4	10		4		11		4	3	9	3	5	2	10	1
	Minimum	1.1	1.1	1.1	1.6		4.5		8.5		1.0	1.3	17	1.4	5.3	1.2	12	0.24
	Maximum	1.8	3.7	1.7	90		8.0		160		4.4	2.1	280	15	58	1.8	360	0.24
	Median	1.5	1.9	1.6	43		6.2		66		2.1	2.0	80	2.9	6.4	1.5	145	0.24
	Average	1.5	2.1	1.5	42		6.2		79		2.4	1.8	92	6.4	16	1.5	157	0.24