This document contains the appendices for the report on characterization of nitrogen compounds for four cruise ships operating in Alaska. The appendices include analytical results, data review, and the sampling and analysis plan for sampling during the 2005 Alaska cruise season. The report can be downloaded from:
http://www.epa.gov/owow/oceans/cruise_ships/nitrogen.html

Sampling Episode Report
Nitrogen Compounds Characterization
Appendices for
Sampling Episodes 6517 Through 6520

November 2006

Appendix A

ANALYTICAL RESULTS FOR FIELD MEASUREMENTS COLLECTED ONBOARD

Table A-1

Analytical Results Collected Onboard (Field Measurements)
Holland America Veendam, Norwegian Star, Island Princess, and Holland America Oosterdam –
1 August through 31 August 2005

Field measurement data and observations for each grab and grab composite sample for each sampling point. Figures 2-1 identify sampling point locations.

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Veendam – Influent to Zenon Treatment System (SP-1) Week 1	0927 on 8/3/05	27.8	5.2	~15	Dark brown, cloudy
	1102 on 8/3/05	27.3	6.5	~75	
	1317 on 8/3/05	27.7	6.5	~100	
	1545 on 8/3/05	26.8	5.8	~30	
Veendam – Influent to Zenon Treatment System (SP-1) Week 2	0832 on 8/11/05	27.4	6.9	~75	Slightly cloudy, yellow
	0955 on 8/11/05	28.7	7.1	~100	Slightly cloudy, yellow, slight odor
	1209 on 8/11/05	27.6	6.4	~30	Slightly cloudy, yellow, some odor
	1432 on 8/11/05	28.4	6.4	~50	
Veendam – Influent to Zenon Treatment System (SP-1) Week 3	0805 on 8/17/05	27.8	7.3	~150	Brown, cloudy
	0951 on 8/17/05	25.5	7.3	~100	Brown, cloudy, odor
	1155 on 8/17/05	28.3	6.9	~100	
	1439 on 8/17/05	28.4	6.3	~90	Yellowish-brown, cloudy
Veendam – Influent to Zenon Treatment System (SP-1) Week 4	0832 on 8/25/05	25.5	6.7	~80	Light brown, cloudy, some odor
	0956 on 8/25/05	27.0	7.3	~120	
	1155 on 8/25/05	26.7	7.1	~100	
	1500 on 8/25/05	28.5	7.2	~120	
Veendam – Influent to Zenon Treatment System (SP-1) Week 5	0831 on 8/31/05	27.5	7.5	~300	Brown, settleable solids, odor
	1045 on 8/31/05	25.7	7.0	~175	
	1246 on 8/31/05	26.2	6.7	~75	
	1435 on 8/31/05	25.5	6.1	~50	
Veendam – Effluent from Zenon Treatment System (SP-2) Week 1	0830 on 8/3/05	31.3	7.2	~15	All samples were clear, no turbidity, slight yellow color
	1058 on 8/3/05	31.6	7.2	~15	
	1313 on 8/3/05	31.1	7.1	~15	
	1542 on 8/3/05	30.7	7.1	~15	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Veendam – Effluent from Zenon Treatment System (SP-2)	0830 on 8/11/05	31.3	7.5	~0	Clear, no color
	0951 on 8/11/05	31.7	7.3	~0	
	1206 on 8/11/05	31.7	7.1	~5	Slightly cloudy, no color
Week 2	1426 on 8/11/05	31.4	7.0	~0	
Veendam – Effluent from Zenon Treatment System (SP-2)	0805 on 8/17/05	31.3	7.3	~10	Slightly yellow, cloudy
	0948 on 8/17/05	30.1	7.5	~10	
	1149 on 8/17/05	31.7	7.3	~20	
Week 3	1436 on 8/17/05	32.1	7.2	~15	
Veendam – Effluent from Zenon Treatment System (SP-2)	0828 on 8/25/05	29.2	7.4	~0	No color, cloudy
	0954 on 8/25/05	30.1	7.5	~0	
	1150 on 8/25/05	30.1	7.4	~0	
Week 4	1445 on 8/25/05	29.9	7.4	~0	
Veendam – Effluent from Zenon Treatment System (SP-2)	0828 on 8/31/05	30.5	7.3	~0	Slightly yellow color, cloudy
	1041 on 8/31/05	30.8	7.3	~0	
	1244 on 8/31/05	29.6	7.3	~30	
Week 5	1431 on 8/31/05	30.4	7.3	~30	
Star –Influent to Scanship Treatment System (SP-3)	1615 on 8/2/05	25.7	6.7	~40	Slightly cloudy, some settable solids, strong odor
	1756 on 8/2/05	26.4	6.5	~30	
Week 1	1954 on 8/2/05	27.8	6.5	~30	
	2103 on 8/2/05	28.7	6.3	~35	
Star –Influent to Scanship Treatment System (SP-3)	1534 on 8/9/05	27.5	6.9	~30	Slightly yellow, some odor
	1654 on 8/9/05	29.8	7.1	~250	
Week 2	1908 on 8/9/05	28.7	8.0	~275	
	2105 on 8/9/05	28.0	6.9	~75	
Star –Influent to Scanship Treatment System (SP-3)	1523 on 8/16/05	28.4	7.1	~150	Brownish-yellow, some settleable solids, some odor, cloudy
Week 3	1659 on 8/16/05	27.7	6.4	~50	Dark yellow, cloudy
	1915 on 8/16/05	27.6	7.0	~50	
	2105 on 8/16/05	28.0	8.0	~200	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Star –Influent to Scanship Treatment System (SP-3) Week 4	1534 on 8/23/05	26.3	6.8	~45	Slightly brown, cloudy, settleable solids
	1652 on 8/23/05	27.3	6.7	~50	
	1915 on 8/23/05	26.6	6.6	~45	Slightly lighter brown, cloudy, settleable solids, stronger odor
	2106 on 8/23/05	28.7	6.3	~40	
Star –Influent to Scanship Treatment System (SP-3) Week 5	1521 on 8/30/05	26.6	6.8	~100	Dark yellow, cloudy
	1654 on 8/30/05	26.9	6.6	~75	Brown, some settleable solids
	1920 on 8/30/05	26.3	6.7	~50	Light brown, some settleable solids
	2105 on 8/30/05	27.4	7.3	~200	Brown, some settleable solids
Star –Effluent from Scanship Treatment System (SP-4) Week 1	1530 on 8/2/05	29.5	6.5	~100	Clear, no color or turbidity
	1747 on 8/2/05	29.1	6.3	~40	
	1944 on 8/2/05	28.5	6.4	~25	
	2056 on 8/2/05	28.2	6.4	~25	
Star –Effluent from Scanship Treatment System (SP-4) Week 2	1530 on 8/9/05	27.6	6.7	~40	Clear, no color
	1650 on 8/9/05	28.8	6.6	~50	
	1906 on 8/9/05	29.6	6.7	~35	
	2100 on 8/9/05	29.8	6.5	~50	
Star –Effluent from Scanship Treatment System (SP-4) Week 3	1516 on 8/16/05	29.8	6.7	~100	No color, cloudy
	1651 on 8/16/05	30.3	6.6	~100	
	1710 on 8/16/05	30.3	6.6	~75	
	2059 on 8/16/05	30.5	6.5	~45	
Star –Effluent from Scanship Treatment System (SP-4) Week 4	1528 on 8/23/05	28.8	6.5	~100	No color, cloudy
	1648 on 8/23/05	29.0	6.4	~100	
	1908 on 8/23/05	29.0	6.4	~50	
	2102 on 8/23/05	29.3	6.4	~40	
Star –Effluent from Scanship Treatment System (SP-4) Week 5	1514 on 8/30/05	28.1	6.5	~100	No color, clear
	1650 on 8/30/05	28.8	6.5	~150	
	1915 on 8/30/05	29.2	6.5	~75	
	2100 on 8/30/05	29.4	6.7	~50	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Island –Influent to Hamworthy Treatment System (SP-5) Week 1	0800 on 8/2/05	31.0	7.0	~15	Clear, slight settleable solids
	0945 on 8/2/05	35.9	8.5	~300	Dark brown, opaque, heavy settleable solids
	1216 on 8/2/05	31.2	7.1	~15	Clear, slight settleable solids
	1408 on 8/2/05	31.1	7.1	~10	
Island –Influent to Hamworthy Treatment System (SP-5) Week 2	0730 on 8/10/05	30.9	7.1	~5	Clear, no color
	0936 on 8/10/05	31.0	8.3	~225	Light brown, cloudy, some settleable solids
	1146 on 8/10/05	31.1	7.3	~5	Clear, no color
	1405 on 8/10/05	31.1	7.2	~0	
Island –Influent to Hamworthy Treatment System (SP-5) Week 3	0748 on 8/16/05	37.0	8.5	~400	Dark brown, settleable solids
	1010 on 8/16/05	31.9	7.3	~0	No color, cloudy
	1209 on 8/16/05	38.6	8.4	>400	Dark brown, settleable solids
	1429 on 8/16/05	31.9	7.5	~0	No color, cloudy
Island –Influent to Hamworthy Treatment System (SP-5) Week 4	0715 on 8/24/05	33.1	8.5	>400	Dark brown, settleable solids, strong odor
	0938 on 8/24/05	30.9	7.5	~35	No color, cloudy, some settleable solids
	1148 on 8/24/05	37.0	8.4	~300	Dark brown, settleable solids, strong odor
	1401 on 8/24/05	30.5	7.1	~15	No color, cloudy, some settleable solids
Island –Influent to Hamworthy Treatment System (SP-5) Week 5	0817 on 8/30/05	31.5	7.3	~5	No color, cloudy
	1046 on 8/30/05	31.0	7.4	~5	
	1214 on 8/30/05	30.8	7.5	~5	
	1420 on 8/30/05	30.7	7.7	~5	
Island – Effluent from Hamworthy Treatment System System (SP-6) Week 1	0810 on 8/2/05	40.2	6.7	~35	Clear, light amber color
	0953 on 8/2/05	40.8	7.0	~75	
	1225 on 8/2/05	41.4	7.1	~80	
	1415 on 8/2/05	42.6	6.7	~35	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Island –Effluent from Hamworthy Treatment System (SP-6)	0739 on 8/10/05	41.7	6.7	~5	Clear, slight yellow color
	0943 on 8/10/05	43.1	7.1	~50	
	1150 on 8/10/05	41.8	6.9	~75	
Week 2	1409 on 8/10/05	41.5	6.9	~40	
Island –Effluent from Hamworthy Treatment System (SP-6)	0754 on 8/16/05	37.5	6.9	~0	No color, cloudy
	1016 on 8/16/05	39.7	7.1	~75	
	1211 on 8/16/05	39.2	7.0	~75	
Week 3	1434 on 8/16/05	40.3	6.9	~40	
Island –Effluent from Hamworthy Treatment System (SP-6)	0720 on 8/24/05	37.4	6.9	~15	Tint of yellow, cloudy, smell of chlorine
	0943 on 8/24/05	38.5	7.35	~175	Yellow, cloudy
Week 4	1152 on 8/24/05	38.6	7.3	~180	
	1406 on 8/24/05	38.9	7.2	~150	
Island –Effluent from Hamworthy Treatment System (SP-6)	0835 on 8/30/05	38.2	7.3	~75	Slightly yellow, clear
	1050 on 8/30/05	39.3	7.5	>400 (test strip was dark brown)	
Week 5	1218 on 8/30/05	39.3	7.5	>400 (test strip was dark brown)	
	1424 on 8/30/05	38.4	7.2	~100 (test strip was brown)	
Oosterdam –Influent to ROCHEM Graywater Treatment System (SP-7)	1110 on 8/1/05	24.9	7.5	~10	Clear, slightly colored
	1330 on 8/1/05	27.7	7.1	~10	
	1545 on 8/1/05	27.3	6.9	~10	
Week 1	1810 on 8/1/05	26.9	6.7	~10	
Oosterdam –Influent to ROCHEM Graywater Treatment System (SP-7)	1136 on 8/8/05	27.2	6.7	~5	Clear, slightly colored
	1416 on 8/8/05	28.0	6.7	~0	
	1613 on 8/8/05	27.5	6.9	~0	
Week 2	1830 on 8/8/05	31.1	7.1	~0	
Oosterdam –Influent to ROCHEM Graywater Treatment System (SP-7)	1213 on 8/15/05	27.4	6.7	~0	Clear
	1455 on 8/15/05	28.6	6.8	~0	
	1706 on 8/15/05	30.5	7.1	~0	No color, cloudy
Week 3	1852 on 8/15/05	30.4	6.9	~0	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Oosterdam –Influent to ROCHEM Graywater Treatment System (SP-7)	1152 on 8/22/05	24.0	6.9	~0	No color, cloudy
	1345 on 8/22/05	26.3	6.9	~0	
	1610 on 8/22/05	27.7	6.5	~0	
Week 4	1826 on 8/22/05	28.2	6.4	~0	
Oosterdam –Influent to ROCHEM Graywater Treatment System (SP-7)	1148 on 8/29/05	25.9	7.3	~5	No color, cloudy, odor
	1352 on 8/29/05	27.5	7.4	~5	
	1610 on 8/29/05	26.7	7.5	~0	
Week 5	1834 on 8/29/05	30.6	7.9	~0	
Oosterdam – Effluent from ROCHEM Graywater Treatment System (SP-8)	1120 on 8/1/05	26.9	7.1	~10	Clear, no color
	1335 on 8/1/05	28.7	6.9	~10	
	1550 on 8/1/05	29.0	6.8	~10	
Week 1	1815 on 8/1/05	28.7	6.9	~5	
Oosterdam – Effluent from ROCHEM Graywater Treatment System (SP-8)	1145 on 8/8/05	28.7	6.7	~5	Clear, no color
	1421 on 8/8/05	30.3	9.3	~0	
	1618 on 8/8/05	30.1	7.1	~0	
Week 2	1832 on 8/8/05	30.7	7.7	~0	
Oosterdam – Effluent from ROCHEM Graywater Treatment System (SP-8)	1220 on 8/15/05	29.9	7.1	~0	Clear
	1459 on 8/15/05	30.3	7.1	~0	
	1709 on 8/15/05	31.0	7.1	~0	Clear, odor
Week 3	1854 on 8/15/05	31.6	6.9	~0	Clear
Oosterdam – Effluent from ROCHEM Graywater Treatment System (SP-8)	1159 on 8/22/05	26.4	7.6	~0	No color, cloudy
	1346 on 8/22/05	28.1	7.0	~0	
	1612 on 8/22/05	29.2	9.3	~0	
Week 4	1830 on 8/22/05	30.7	6.8	~0	
Oosterdam – Effluent from ROCHEM Graywater Treatment System (SP-8)	1156 on 8/29/05	27.5	7.7	~0	No color, slightly cloudy
	1355 on 8/29/05	29.6	7.7	~0	
	1615 on 8/29/05	29.4	9.1	~0	
Week 5	1836 on 8/29/05	29.2	8.5	~0	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Oosterdam – Influent to ROCHEM Sewage/Graywater Treatment System (SP-9) Week 1	1133 on 8/1/05	25.3	7.1	~150	Opaque, highly turbid, dark brown in color
	1344 on 8/1/05	26.2	7.7	~200	
	1555 on 8/1/05	25.9	6.9	~200	
	1825 on 8/1/05	26.3	6.7	~150	
Oosterdam – Influent to ROCHEM Sewage/Graywater Treatment System (SP-9) Week 2	1207 on 8/8/05	26.1	8.0	~300	Cloudy, highly turbid, medium brown color, strong odor
	1428 on 8/8/05	26.5	7.2	~150	
	1625 on 8/8/05	26.6	7.1	~150	
	1839 on 8/8/05	26.7	7.5	~150	
Oosterdam – Influent to ROCHEM Sewage/Graywater Treatment System (SP-9) Week 3	1243 on 8/15/05	25.3	7.1	~300	Brown, settleable solids, odor
	1510 on 8/15/05	24.3	7.2	~125	
	1721 on 8/15/05	24.1	7.3	~150	
	1904 on 8/15/05	26.0	7.6	~150	
Oosterdam – Influent to ROCHEM Sewage/Graywater Treatment System (SP-9) Week 4	1210 on 8/22/05	25.6	7.0	~200	Brown, cloudy, odor
	1350 on 8/22/05	26.7	6.9	~250	Brown, cloudy, some settleable solids
	1621 on 8/22/05	28.5	6.6	~102	
	1834 on 8/22/05	26.9	6.7	~150	
Oosterdam – Influent to ROCHEM Sewage/Graywater Treatment System (SP-9) Week 5	1205 on 8/29/05	25.7	7.5	~200	Brown, some settleable solids
	1406 on 8/29/05	26.4	7.6	~150	
	1622 on 8/29/05	24.6	7.1	~150	Brown, some settleable solids, strong odor
	1840 on 8/29/05	25.3	7.0	~120	Brown, some settleable solids
Oosterdam – Effluent from ROCHEM Sewage/Graywater Treatment System (SP-10) Week 1	1142 on 8/1/05	30.8	7.0	~50	Slightly turbid, light amber in color
	1348 on 8/1/05	30.7	7.1	~100	
	1600 on 8/1/05	31.1	7.1	~100	
	1830 on 8/1/05	31.8	7.0	~50	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Oosterdam – Effluent from ROCHEM Sewage/Graywater Treatment System (SP-10)	1210 on 8/8/05	30.3	7.4	~100	Slightly turbid, light amber in color
	1431 on 8/8/05	30.9	7.3	~100	
	1628 on 8/8/05	31.0	7.4	~100	
Week 2	1838 on 8/8/05	31.4	7.3	~100	
Oosterdam – Effluent from ROCHEM Sewage/Graywater Treatment System (SP-10)	1246 on 8/15/05	32.1	7.3	~100	Yellow, cloudy
	1512 on 8/15/05	32.4	7.3	~75	Yellow, cloudy, slight odor
	1725 on 8/15/05	32.6	7.2	~100	
Week 3	1905 on 8/15/05	32.2	7.3	~75	
Oosterdam – Effluent from ROCHEM Sewage/Graywater Treatment System (SP-10)	1214 on 8/22/05	29.8	7.3	~100	Slightly brown, cloudy
	1354 on 8/22/05	30.4	7.5	~100	
	1624 on 8/22/05	32.1	7.4	~100	
Week 4	1837 on 8/22/05	32.9	7.1	~75	
Oosterdam – Effluent from ROCHEM Sewage/Graywater Treatment System (SP-10)	1209 on 8/29/05	31.3	7.3	~150	Slightly yellow, cloudy, smell of urine
	1410 on 8/29/05	31.3	7.3	~150	Slightly yellow, cloudy
	1625 on 8/29/05	30.7	7.3	~125	
Week 5	1842 on 8/29/05	30.9	7.4	~150	Slightly yellow, cloudy, odor
Oosterdam – Final Combined Treated Effluent (SP-11)	1150 on 8/1/05	28.1	7.3	~100	Clear, slight yellow color
	1355 on 8/1/05	29.5	7.1	~50	
	1605 on 8/1/05	29.5	7.1	~50	
Week 1	1835 on 8/1/05	30.0	6.9	~0	
Oosterdam – Final Combined Treated Effluent (SP-11)	1157 on 8/8/05	29.9	7.0	~30	Clear, slight yellow color
	1435 on 8/8/05	30.7	7.3	~30	
	1633 on 8/8/05	30.7	7.5	~30	
Week 2	1844 on 8/8/05	31.0	7.3	~15	
Oosterdam – Final Combined Treated Effluent (SP-11)	1232 on 8/15/05	30.2	6.9	~5	Clear
	1504 on 8/15/05	30.3	7.1	~25	
	1715 on 8/15/05	31.1	7.1	~40	No color, cloudy
Week 3	1859 on 8/15/05	31.6	7.1	~30	

Table A-1 (Continued)

Sampling Point	Sample Collection Time	Temperature (ºC)	pH	Ammonium (mg/L)	Comments
Oosterdam – Final Combined Treated Effluent (SP-11)	1220 on 8/22/05	28.5	7.1	~30	No color, cloudy
	1356 on 8/22/05	31.1	7.3	~25	
	1630 on 8/22/05	30.7	7.1	~20	
Week 4	1839 on 8/22/05	31.4	7.1	~35	
Oosterdam – Final Combined Treated Effluent (SP-11)	1215 on 8/29/05	28.5	7.3	~30	No color, cloudy
	1415 on 8/29/05	30.0	7.3	~40	
	1630 on 8/29/05	25.3	7.1	~75	Slight yellow color, cloudy
Week 5	1847 on 8/29/05	30.6	7.3	~120	

Appendix B

DATA REVIEW NARRATIVE

MEMORANDUM

TO: Don Anderson, EPA

FROM: Debra Falatko, ERG
Jenny Van, ERG

DATE: December 12, 2005

SUBJECT: **Quality Assurance Review of Laboratory Data Collected From Large Cruise Ships in Alaska Waters**

This memorandum presents the results and finding of ERG's data review of the laboratory results from cruise ship sampling episodes 6517 through 6520. ERG's contract laboratory, Analytica Alaska Inc. (Analytica) performed analyses for the following analytes: ammonia, total Kjeldahl nitrogen (TKN), chemical oxygen demand (COD), total suspended solids (TSS), and nitrate/nitrite. ERG's review adheres to Section 3 of the Wet Chemistry Data Review Guidelines provided in the *Addendum to the Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Waters* dated 9 August 2005. The organization of this memorandum corresponds to those data review guidelines. Based on this review, all data for these sampling episodes are considered to be of acceptable quality with the qualifications described below and as summarized in the Overall Data Quality Assessment provided at the end of this memorandum. ERG marked the corrections in the data log sheets for inclusion in the Cruise Ship Rulemaking Record.

Completeness

All samples collected were analyzed by the laboratory for a completeness of 100%. See the sample traffic reports provided in the laboratory data summary packages in the Cruise Ship Rulemaking Record for a list of samples and analyses.

ERG found a few errors in Analytica's schedule files for sampling weeks 1 and 2, which misidentified three nitrate/nitrite samples as TSS samples:

- In week 1 for Nitrate/Nitrite data, samples J0508035_01E and J0508035_02E are missing from the data. The schedule file shows samples J0508035_01D and J0506035_02D instead, which are indicated as TSS samples in the case narratives.
- In week 2 for Nitrate/Nitrite data, sample J0508285_02D is missing from the data. The schedule file shows sample J0508285_02E instead, which are indicated as TSS samples in the case narratives.

ERG contacted Analytica for an explanation. Analytica responded that while the samples were misidentified from the raw data log sheets, they were corrected before Analytica downloaded the numbers to their LIM system, thus having no effect on the data.

Data Package

ERG received all laboratory data packages from sampling episodes 6517 through 6520 from Analytica.

Log Book Pages

All logbook pages from sampling episodes 6517 through 6520 were complete.

Analysis Sequence

Analytica analyzed nitrate/nitrite samples using ion chromatography (IC). Analytical conducted all analyses for the IC according to the required analytical sequence. For all other analyses, Analytica provided analyses dates as specified by the Data Review Guidelines.

Initial Precision and Recovery (IPR)

ERG procured (and Analytica analyzed) double blind performance evaluation (PE) samples in lieu of using outdated Initial Precision and Recovery (IPR) data to assess laboratory performance. ERG's PE sample assessment indicates excellent laboratory precision and accuracy for ammonia and TKN. Nitrate/nitrite data could not be evaluated, as the sample detection limit was higher than the certified PE sample concentration. See the memorandum titled *Performance Evaluation (PE) Samples for Evaluating Laboratory Analysis Performance* dated 14 November 2005 provided in the Cruise Ship Rulemaking Record for a detailed discussion of the results and findings of the PE samples.

In addition to the PE samples analyzed for this study, ERG obtained and reviewed copies of Analytica's MDL studies and latest PE results performed in June 2005 through September 2005. The results of these studies further verified Analytica's qualifications for performing the test methods used for these cruise ship sampling episodes.

Initial Calibration (ICAL)

An ICAL was performed for all nitrate/nitrate measurements. For ammonia, Analytica uses a self-calibrated instrument, Thermo Orion model 720, which is set up to automatically incorporate calibration values (the true values). Thus, no ICAL was needed for the ammonia analysis.

ICAL does not apply to TKN, TSS, and COD.

Initial Calibration Verification (ICV)

ICV only applies for nitrate/nitrite and ammonia analyses. Analytica conducted an ICV prior to all nitrite/nitrate and ammonia IC samples analyses as specified by the Data Review Guidelines.

Initial Calibration Blank (ICB)

ICB only applies for nitrate/nitrate and ammonia analyses. For nitrite/nitrate and ammonia analyses, Analytica analyzed an ICB immediately following every ICV as specified by the Data Review Guidelines.

Continuing Calibration Verification (CCV)

CCV only applies to nitrate/nitrite and ammonia analyses. For all nitrite/nitrate IC analyses, Analytica analyzed a CCV following every ten analytical samples and at the end of each sample run as specified by the Data Review Guidelines. For ammonia, Analytica also analyzed a CCV after every measurement to ensure the probes were not contaminated; this procedure is not required by the Data Review Guidelines.

CCV does not apply to TSS, COD, and TKN.

Continuing Calibration Blank (CCB)

For all nitrite/nitrate IC analyses, Analytica analyzed a CCB immediately following every CCV as specified by the Data Review Guidelines. For ammonia, Analytica analyzed a CCB immediately following the CCV that followed every ten analytical samples and at the end of each sample run as specified by the Data Review Guideline. CCBs were not performed for the additional CCVs because the Data Review Guidelines did not require them.

CCB does not apply to TSS, COD, and TKN.

Standards

Analysis of laboratory standards, rather than ICV and CCV, is required for TKN, TSS and COD analyses. Analytica met this requirement by running a Laboratory Control Standard (LCS) before each analysis, which is equivalent to a standard.

Preparation Blanks (PB)

Preparation blanks were referred to as method blanks (MB) in the log book pages. For all nitrite/nitrate IC analyses, a MB was prepared for every twenty field samples as specified by the Data Review Guidelines. For ammonia and TKN, a MB was prepared for every twenty field samples as specified by the Data Review Guidelines. For TSS and COD, a blank was analyzed in the beginning of every set of analysis as specified by the Data Review Guidelines.

Reagent Water Blanks (BLK)

Analytica met this requirement for the TKN, TSS, and COD analyses by running a preparation blank before each set of analyses.

Reagent water blanks only apply to TKN, TSS, and COD.

Ongoing Precision and Recovery (OPR)

Ongoing precision and recovery (OPR) was referred to as laboratory control standard (LCS) and laboratory control standard duplicate (LCSD) in the log book pages. For all nitrite/nitrate, COD, and ammonia analyses, a LCS and LCSD pair was analyzed for every twenty field samples as specified by the Data Review Guidelines. For TKN, only a LCS was analyzed; this is acceptable because there is no requirement for a duplicate in the method.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

For all nitrite/nitrate IC analyses, a MS and MSD pair was analyzed for every ten samples as specified by the Data Review Guideline.

MS and MSD samples were prepared and analyzed for ammonia, COD and TKN analyses as specified by the Data Review Guidelines with the following exceptions:

- For ammonia for sampling week 2, only one MS/MSD pair was analyzed for a set of 12 samples;
- For COD for week 2, the MSD is missing for the second MS/MSD pair;
- For TKN for week 3, Analytica analyzed an MS for each of three sets of ten samples but analyzed an MSD for only one of these sets.

There is no indication that the reduced frequency of MS/MSD analyses in these three instances had any impact on the quality of the sample data.

The MS/MSD analysis does not apply for TSS.

Duplicate Analysis

The field duplicate analysis requirement only applies for TSS. The sampling team collected and submitted one field duplicate sample for every ten TSS samples, as specified by the Data Review Guidelines.

Holding Times

All analyses for ammonia, TKN, TSS, COD, nitrate/nitrite met the holding time requirement as specified by the Data Review Guidelines.

IPR Recoveries

See discussion of IPR above.

ICV, CCV, and Standards Recoveries

All ICV, CCV, and standards recoveries for ammonia, TKN, nitrite/nitrate, and COD were within 90% - 110% of the spiked amount as specified by the Data Review Guidelines.

OPR Recoveries

All OPR recoveries for ammonia, TKN, nitrate/nitrite, and COD were within the range of 80-120% of the spiked amount as specified by the Data Review Guidelines.

ICB, CCB, Preparation Blank and Reagent Water Blank Contamination

ICB, CCB, preparation blank, and reagent water blanks were free of contamination, with the following exceptions:

For nitrate/nitrite IC calibration, there was contamination in the ICB, CCB and preparation blanks in the following sample runs:

- Week 2: Standard CCB— the nitrite concentration reported in the blank was 0.0153 mg/L for one standard CCB, which was higher than the detection limit (0.0011 mg/L);

- Week 5: Standard CCB— the nitrite concentrations reported in the standard CCB blanks were 0.0153 mg/L, which were higher than the detection limit (0.0011 mg/L)

ERG contacted Analytica to verify the nitrate/nitrite concentrations. Analytica responded that even though 0.0153 mg/L was higher than the detection limit, it was still lower than the laboratory's practical quantitation limit (PQL) 0.05 mg/L.

In addition, ERG reviewed the nitrate/nitrite sample results associated with the elevated blanks to determine the impact of the blank on the sample results. All of the associated sample results were greater than 10 times the blank result, indicating that the presence of nitrite in the blanks did not adversely affect the data.

For ammonia data, the following blanks showed contamination:

- Week 3: CCB—the ammonia concentration reported in the blank was 0.079 mg/L, which was higher than the detection limit (0.05 mg/L).

- Week 5: CCB—the ammonia concentration reported in the blank was 0.102 mg/L, which was higher than the detection limit (0.05 mg/L); and

ERG reviewed the ammonia sample results associated with the elevated blanks to determine the impact of the blank on the sample results. All of the associated sample results were greater than 10 times the blank result, indicating that the presence of ammonia in the blanks did not adversely affect the data.

Matrix Spike and Matrix Spike Duplicates

Analytica provided MS/MSD reports for ammonia, COD, TSS and nitrate/nitrite. Analysis of MS/MSD analysis is not applicable for TSS. ERG verified the lab's calculations of the percent recoveries and relative percent differences (RPDs). All MS/MSD percent recoveries were between 75- 125 % as specified by the Data Review Guideline. All relative percentage differences (RPD) were within the 20% range as specified by the Data Review Guidelines.

Duplicate Analysis

Duplicate analyses met the requirements specified in the Data Review Guidelines.

ERG found an error in Analytica's calculations for RPD (TSS):

- Week 4: The %RPD was incorrectly reported as 3.81%, the correct %RPD is 3.79%.

ERG contacted Analytica about this calculation error. Analytica responded that the discrepancy in the %RPD comes from at what point the calculation was made. Analytica calculated the %RPD on samples that have been diluted before the dilution factor has been applied, in which case the %RPD for the above TSS sample would be 3.81%. ERG has requested Analytica that for future TSS analyses, the laboratory calculate %RPD using only the true value of the sample after dilution and adjustments, instead of using the raw data. ERG marked the corrections in the data log sheets for inclusion in the Cruise Ship Rulemaking Record

Some %RPDs and MSD percent recovery calculations were missing from Analytica's data summary package. ERG performed the calculations and verified the results were within recovery range as specified by the Data Review Guidelines. During week 3, the lab did not calculate %R for J0508185_04 MSD; however, the results were within recovery range as specified by the Data Review Guidelines. During week 4,the lab did not calculate the % R for J0508252_05 MSD; however, the results were within recovery range as specified by the Data Review Guidelines. The lab did not calculate MSD %R for J0508285_02; however, the results were within recovery range as specified by the Data Review Guidelines. During week 5: The lab did not calculate the %R for J0508325_02 MSD; however, the results were within recovery range as specified by the Data Review Guidelines. ERG marked the corrections in the data log sheets for inclusion in the Cruise Ship Rulemaking Record.

Sample Dilutions and Results Exceeding the Calibration Range

The calibration range for nitrate and nitrite is 0 to 10 mg/L. All standard and sample results were within the calibration range, except for the following:

- The nitrite concentration for sample 66486 (J0508032-01E-MS) was 55.8353 mg/L, which exceeded the calibration range.
- The nitrite concentration for sample 66486 (J0508032-01E-MSD was 56.2701, which exceeded the calibration range.

ERG contacted Analytica for an explanation. Analytica responded that the nitrite concentrations exceeded the calibration range because the results were taken from raw data sheets with high concentrations. Due to matrix interference, the IC program misidentified the peaks, thus reporting nitrite at such high concentrations. These concentrations were not ultimately used in the data but were presented in the data packet. The nitrite samples were rerun later at a higher dilution factor so the peak resolution was clearer. Only data from the rerun samples were reported.

Multiple Qualifiers

No multiple qualifiers were identified in the data sets.

Exclude Data

No data were excluded from the results.

Logic Check

In theory, TKN concentrations in any given sample should be greater than ammonia concentrations for that same sample because TKN measures both ammonia and organic forms of nitrogen. For these sampling episodes, ten effluent from treatment samples exhibited TKN concentrations lower than ammonia concentrations; the remaining effluent samples exhibited TKN concentrations greater than, but similar to, ammonia concentrations. These results suggest that organic forms of nitrogen are removed by the wastewater treatment system, resulting in only ammonia nitrogen present in the effluent from treatment. If this is the case, differences in TKN and ammonia concentrations in the ffluent are likely the result of analytical variability, which should be within 20%. The following table lists the TKN and ammonia concentrations in the ten effluent samples and confirms that the relative percent difference between these analyte concentrations are less than 20%.

Ship/ Treatment System	Sample Number	Ammonia as Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Relative Percent Difference (%)
Veendam/ Zenon	66191	17.0	15.6	8.6
Norwegian/ Scanship	66341	32.0	27.4	14
Norwegian/ Scanship	66347	38.0	37.8	0.53
Norwegian/ Scanship	66349	37.0	33.5	9.9
Norwegian/ Scanship	66342	31.0	27.4	12
Island/ Hamworthy	66491	29.0	26.7	8.3
Island/ Hamworthy	66495	44.0	42.0	4.7
Oosterdam/ ROCHEM Sewage/Graywater	66652	38.0	36.8	3.2
Oosterdam/ ROCHEM Sewage/Graywater	66656	41.0	40.6	0.98
Oosterdam/ Final Combined Treated Effluent	66658	27.0	25.4	6.1

Overall Data Quality Assessment

This data validation assessment indicates all the ammonia, TKN, nitrate/nitrite, COD and TSS data collected during sampling episodes 6517 through 6520 can be used for the large cruise ship rulemaking effort.

Appendix C

SAMPLING AND ANALYSIS PLAN FOR NITROGEN COMPOUNDS CHARACTERIZATION SAMPLING EPISODES 6517 THROUGH 6520 2005 ALASKA CRUISE SEASON

United States Environmental Protection Agency

Sampling and Analysis Plan for Nitrogen Compounds Characterization Sampling Episodes 6517 Through 6520 2005 Alaska Cruise Season

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
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July 2005

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

1.0 INTRODUCTION

This plan describes the onboard sampling and analysis activities intended to characterize nitrogen compounds (ammonia, total Kjeldahl nitrogen (TKN), and nitrate/nitrite) concentrations in graywater and sewage generated and discharged by four cruise vessels (Holland America Veendam, Norwegian Star, Island Princess, and Holland America Oosterdam) while in Alaska waters. This sampling program is being performed under the supervision of the Engineering and Analysis Division (EAD) and the Office of Wetlands, Oceans, and Watersheds (OWOW) of the U.S. Environmental Protection Agency (EPA).

This document presents information on the planned sampling episodes and is intended to serve as a guide to the field sampling team, a review mechanism for EPA personnel, and a source of procedural information for vessel personnel. EPA personnel and supporting contractor performed extensive sampling episodes onboard the Holland America Veendam (Veendam), Norwegian Star (Star), Island Princess (Island), and Holland America Oosterdam (Oosterdam) during the 2004 Alaska cruise season. This sampling plan was prepared based on the results from those sampling episodes and from follow-up communication with the Holland America, Norwegian, and Princess cruise lines. Tables and figures are presented at the end of each section.

1.1 Background

This sampling program is part of EPA's data collection effort to develop wastewater discharge regulations for cruise vessels authorized to carry 500 or more passengers for hire and 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 (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).

During the 2004 Alaska cruise season, EPA conducted a large onboard sampling program consisting of sampling episodes onboard four different cruise vessels with four different advanced wastewater treatment systems; each sampling episode consisted of five consecutive 24-hour sampling periods. The sampling program focused on characterizing the pollutants in wastewater (graywater and sewage) onboard cruise vessels, evaluating the performance of advanced shipboard wastewater treatment systems, and analyzing patterns and variability in wastewater. This program is documented in sampling episode reports prepared for each of the sampled cruise vessels, which will be included in the Cruise Ship Rulemaking Record.

While reviewing the 2004 sampling data, EPA identified anomalous results for two of the four ships sampled: Star and Oosterdam. Specifically, for these two sampled ships, ammonia was either not detected (detection limit = 0.05 mg/L) or detected at very low concentrations (<3 mg/L) in all samples of the influent to and effluent from graywater and sewage treatment systems collected over five consecutive days. (EPA expected ammonia concentrations of 12 to 50 mg/L or higher.) EPA also identified anomalous total Kjeldahl nitrogen (TKN) data for one of the four ships sampled – the Star. (EPA expected TKN concentrations higher than, but similar in magnitude to expected ammonia concentrations.) On this ship, TKN concentrations in the same samples were unexpectedly low and variable. Section 1.2 provides additional discussion regarding the reasons why EPA considers the ammonia and TKN data anomalous.

As a result, the primary purpose of the sampling activities described in this plan is to collect additional nitrogen compound data to expand EPA's data set for these important parameters and to provide additional information to assess the usability of the 2004 ammonia and TKN data.

1.2 Discussion of 2004 Ammonia and TKN Results

EPA considers the ammonia data for the Star and the Oosterdam as anomalous for five reasons.

- First, ammonia is produced within humans when proteins are digested and used by the body, and excess ammonia is excreted in urine; therefore, ammonia is expected to be present in combined cruise vessel graywater and sewage.

- Second, ammonia concentrations in typical untreated domestic wastewater range from 12 to 50 mg/L (1); cruise vessel wastewater is expected to be more concentrated than typical domestic wastewater because of the use of water conservation practices such as vacuum toilets. For example, key pollutants commonly used to assess wastewater strength, such as BOD_5, TSS, and COD, were detected at concentrations two to five times greater than typical domestic wastewater.

- Third, samples collected over five consecutive days on the other two ships (the Veendam and the Island) contained ammonia concentrations ranging from 60 to 139 mg/L in the influent to treatment and from 11 to 47.3 mg/L in the effluent from treatment.

- Fourth, 2004 compliance testing data provided by the U.S. Coast Guard (a total of 25 data points) for treated cruise ship wastewater showed ammonia concentrations generally ranging from 4 mg/L to 110 mg/L, with an average concentration 31 mg/L. None of the ammonia concentrations were reported as non-detect.

- Fifth, one of the Alaska Department of Environmental Conservation (ADEC) compliance testing samples was collected during EPA's sampling episode on one of the sampled ships in question (Star). Although the sampling methodology differed (24-hour composite sample for EPA's sample versus grab sample for the compliance sample), the sampling location and analytical test method were identical. EPA's effluent sampling result for ammonia was non-detect (detection limit = 0.05 mg/L), while the compliance sampling result for ammonia was 68 mg/L.

The TKN results for the Star were unexpectedly low and variable as compared to typical domestic wastewater and results from other cruise ships. TKN measures two forms of nitrogen: organic nitrogen and ammonia. Organic nitrogen concentrations in typical untreated domestic wastewater range from 8 to 35 mg/L, while ammonia concentrations range from 12 to

50 mg/L (1). Summing these two nitrogen sources, TKN concentrations in typical untreated domestic wastewater would range from 20 to 85 mg/L. The ranges of detected TKN concentrations in the influent to treatment samples collected over five consecutive days for the four sampled ships are shown below.

Ship	Range of TKN Concentrations in Influent to Treatment (mg/L)
Veendam	86 to 141
Star	0.31 to 83.7
Island	110 to 354
Oosterdam	182 to 200

With the exception of the Star, TKN concentrations fall in a relatively narrow range. In contrast, TKN concentrations for the Star range over two orders of magnitude, as follows:

- Influent TKN concentrations (mg/L) - 3.87, 0.76, 83.7, 6.03, and 0.31; and
- Effluent TKN concentrations (mg/L) - 0.78, 0.76, 46.3, 0.155, and 10.3.

In addition, as discussed previously, ADEC compliance testing was conducted during EPA's sampling episode onboard the Star. EPA's effluent sampling result for TKN was 46.3 mg/L, while the compliance sampling result for ammonia was 60.3 mg/L.

It is important to note that EPA's review of the ammonia and TKN analytical data for all four sampling episodes did not reveal any obvious errors. The quality control results from each laboratory support the results provided and do not suggest any pervasive problems with the analyses (i.e., matrix spike recoveries and ongoing precision and recovery results were well within the acceptance limits, blanks were free of ammonia at the levels of interest). The Veendam and the Island ammonia and TKN samples were analyzed by a different laboratory than the Star and the Oosterdam ammonia and TKN samples. Therefore, EPA believes it is necessary to collect additional nitrogen compound data for these four ships to better assess ammonia and TKN in their wastewater.

1.3 Ship Selection

EPA selected the same four ships that were sampled during its 2004 sampling program to characterize the performance of advanced wastewater treatment systems operated in Alaska waters to provide context for the additional nitrogen compounds data. The sampled vessels were:

- Veendam - Zenon System;
- Star - Scanship System;
- Island - Hamworthy System; and
- Oosterdam - Rochem System.

All four ships were approved by the U.S. Coast Guard for continuous discharge of treated graywater and sewage to Alaska waters during the 2004 and 2005 cruise seasons.

2.0 SHIP OVERVIEW

The following table provides general information for the four sampled cruise vessels:

Ship	Launched	Gross Tons	Number of Passengers (a)	Number of Crew	Length (feet)	Beam (feet)	Number of Decks
Veendam	1996	55,451	1,266	588	720	101	10
Star	2001	91,740	2,240	1,000	965	105	15
Island	2003	88,000	1,950	850	964	106	16
Oosterdam	2003	85,000	1,824	800	951	105.8	11

(a) Based on two per stateroom.

All four ships have a number of dining areas, bars, and cafes located throughout, plus a casino, spa, fitness center, beauty salon, and gift shops. Other amenities include photo labs for developing pictures and a medical center.

Note that certain information has been removed from this section to protect material for which a claim of confidential business information (CBI) has been made. The confidential version of this report can be found in the confidential portion of the Cruise Ship Rulemaking Record.

2.1 Graywater and Sewage Generation, Collection, Holding, and Transfer

Each ship's collection, holding, and transfer (CHT) system collects and transfers graywater and sewage and other miscellaneous wastewaters generated onboard to the ship's graywater and sewage treatment system or to overboard discharge. Each CHT system includes five subsystems referred to by the ship's crew as the galley, food pulper, accommodations, laundry, and sewage systems. Wastewater streams commonly collected by each of the five subsystems are listed below (the list may not be comprehensive, and there is some variation among ships):

- Galley system conveys wastewater from:
  - Dishwashers,
  - Food preparation,
  - Galley sinks, and
  - Galley floor drains;

- Food pulper system conveys wastewater from the ships' food pulper system;

- Accommodations system conveys wastewater from:
  - Passenger and crew room sinks, tubs, showers,
  - Bar sinks,
  - Salon wastewater,
  - Interior deck drains (other than galley, laundry, and medical floor drains),
  - Passenger and crew laundrettes,
  - Service pantries,
  - Steward cleaning stations, and
  - Non-engine-room shop sinks;

- Laundry system conveys wastewater from:
  - Laundries (except passenger and crew laundrettes), and
  - Laundry floor drains;

- Sewage system conveys wastewater from:
  - Passenger and crew toilets and urinals,
  - Medical sinks, and
  - Medical floor drains.

Galley wastewater typically drains through grease traps and into one or more galley wastewater holding tanks. An enzyme is commonly added to the galley wastewater to help degrade the grease. Food pulper wastewater is generated by the ship's system used to grind and dewater food waste. Food pulper wastewater is recirculated within the system and then periodically dumped from the food pulper wastewater holding tank to a storage tank. Gamazyme is typically added for odor control.

Accommodations wastewater generated throughout each ship typically drains to multiple accommodations wastewater collection tanks (e.g., 3 on the Veendam and 11 on the Island). Accommodations wastewater may be pretreated by gross particle filters as the wastewater drains to the collection tanks. Laundry wastewater also typically drains to a single

laundry wastewater holding tank. A vacuum system conveys sewage generated throughout the ships to multiple sewage collection tanks.

The four sampled ships differ regarding which of the five CHT subsystems are routed to wastewater treatment and which are routed to double-bottom holding tanks for discharge without treatment outside 12 nautical miles (nm) from shore. The destinations of the CHT subsystems for each ship are listed below.

Ship	Destination of Wastewater: Treated = Treated and Discharged Continuously Discharged = Discharged Without Treatment Outside 12 nm from Shore				
	Galley	**Food Pulper**	**Accommodations**	**Laundry**	**Sewage**
Veendam	Treated	Treated	Treated	Treated	Treated
Star	Treated	Discharged	Treated	Treated	Treated
Island	Discharged	Discharged	Treated	Discharged	Treated
Oosterdam	Treated	Discharged	Treated	Treated	Treated

The ship-specific sampling episode reports prepared for the 2004 cruise vessel sampling program include additional information regarding the CHT systems operated on the four sampled cruise vessels.

2.2 Graywater and Sewage Treatment Systems

This subsection summarizes the graywater and sewage treatment systems operated onboard each of the sampled vessels. The ship-specific sampling episode reports prepared for the 2004 cruise vessel sampling program include additional information regarding the vessel treatment systems.

2.2.1 Holland America Veendam

The Veendam is outfitted with a Zenon system, an advanced graywater and sewage treatment system comprising aerobic biological oxidation followed by ultrafiltration and UV disinfection. Figure 2-1 is a simplified diagram of the Zenon system.

Wastewater from the graywater storage tanks and sewage collection tanks mixes in a common line, flows through two coarse screens to a collection tank, and is then pumped to the aerated bioreactor. Operators add defoamer (rarely used) and caustic (pH control) to the bioreactor as needed; the ship no longer uses nitrogen (nutrient) addition. Following aeration and biodegradation, the wastewater is pumped to the membrane chamber where it flows through the proprietary ZeeWeed® hollow-fiber ultrafiltration membrane system under a vacuum. Particulate matter and mixed liquor remain in the membrane chamber. A coarse air diffuser scours the external membrane to remove accumulated solids, and these solids, along with the mixed liquor, overflow from the membrane chamber back to the aeration tank. The system also backwashes the membranes every eight minutes to keep the membranes clean. Small amounts of citric acid and sodium hypochlorite are added to the membrane backwash tank on alternate days to enhance cleaning. In the final stage of treatment, the membrane permeate undergoes UV disinfection. The system operates continuously, regardless of the ship's location (e.g., in port, at sea, outside Alaska waters).

The Zenon system can treat 700 m^3 (185,000 gallons) per day of sewage and graywater generated onboard, well in excess of its typical daily load, approximately 350 m^3 (92,500 gallons), based on interviews with the ship's crew.

The vessel typically continuously discharges overboard. When overboard discharge is restricted, such as when the cruise vessel enters Glacier Bay National Park, the treated effluent is diverted to double-bottom ballast tanks, where it is held for eventual discharge overboard outside 12 nm.

2.2.2 Norwegian Star

The Star is outfitted with a Scanship treatment system, an advanced wastewater treatment system that uses aerobic biological oxidation followed by dissolved air flotation and UV disinfection. Figure 2-2 is a simplified diagram of the Scanship treatment system. (Figure 2-2 has been modified to prevent disclosure of material for which a claim of CBI has been made.)

Wastewater from the galley, accommodations, laundry, and sewage CHT subsystems combine in one graywater and sewage holding tank. (Note that food pulper wastewater is not routed to the graywater and sewage holding tank, but instead is discharged without treatment outside 12 nm from shore.) The combined wastewater is then pumped through two coarse drum filters operated in parallel (mesh size 0.5mm) and then through two aerated bioreactors operated in series. Each bioreactor contains free floating plastic beads to support biological growth. Operators add a defoaming agent to the bioreactors. Following aeration and biodegradation in the bioreactors, the wastewater is pumped to two dissolved air flotation (DAF) units operated in parallel to separate solids. Anionic polymer and flocculant (polyaluminum chloride) are added to the wastewater to aid the flotation process.

From the DAF units, the wastewater is pumped to two polishing screen filters operated in parallel (mesh size 0.03 mm). In the final stage of treatment, the wastewater undergoes UV disinfection in three parallel UV units for destruction of bacteria and viruses. The UV units are cleaned approximately every three weeks using Metalbrite solutions containing 80% water and 20% phosphoric acid. The Metalbrite solution is reused until spent.

According to the ship's crew, the Scanship treatment system can treat 1,400 m^3 (370,000 gallons) per day of wastewater generated onboard. This is well in excess of its typical daily load, approximately 840 m^3 (222,000 gallons), as determined based on interviews with the ship's crew.

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

2.2.3 Island Princess

The Island is outfitted with a Hamworthy system, an advanced graywater and sewage treatment system comprising two-stage aerobic biological oxidation followed by membrane filtration and UV disinfection. Figure 2-3 is a simplified diagram of the Hamworthy system.

Wastewater from the sewage evacuation tanks and the accommodations graywater buffer tanks mix in a common line, flows through the first stage screen presses (which filter paper and other solids from the wastewater), and enters the first stage bioreactors. Following aeration and biodegradation in the first-stage bioreactor, the wastewater is pumped through Russel bag filters and into the second stage bioreactors for additional aeration and biodegradation. Next, the wastewater is pumped through the membrane filters and collected into permeate tanks. In the final stage of treatment, the membrane permeate undergoes UV disinfection. The system operates continuously, regardless of the ship's location (e.g., in port, at sea, outside Alaska waters).

The Hamworthy system can treat 480 m^3 (127,000 gallons) per day of sewage and accommodations graywater generated onboard, well in excess of its typical load, approximately 350 m^3 (92,500 gallons), based on interviews with the ship's crew and measured flows collected during the sampling episode.

The vessel typically continuously discharges overboard. When overboard discharge is restricted, such as when the vessel enters Glacier Bay National Park, the treated effluent is diverted to double-bottom ballast tanks, where it is held for eventual discharge overboard outside of 12 nm.

2.2.4 Holland America Oosterdam

The Oosterdam's advanced wastewater treatment system consists of two different Rochem (reverse osmosis) systems designed to treat graywater and sewage separately. Laundry and accommodations wastewater are routed to the graywater treatment system. Galley

wastewater, sewage, and membrane concentrate from the graywater treatment system are treated by the graywater/sewage treatment system. Figure 2-4 is a simplified diagram of the graywater Rochem system, and Figure 2-5 is a simplified diagram of the graywater/sewage Rochem system.

The graywater and graywater/sewage treatment systems combined are capable of treating 875 m^3 per day (231,000 gallons) of wastewater, well in excess of its typical daily load, approximately 530 m^3,(140,000 gallons), based on interviews with the ship's crew and measured flows collected during the sampling episode.

Treated effluent from the two systems is combined for discharge through a single port. The vessel typically continuously discharges overboard. When overboard discharge is restricted, such as when the cruise vessel enters Glacier Bay National Park, the treated effluent is diverted to double-bottom ballast tanks, where it is held for eventual discharge overboard outside 12 nm. The treatment systems operate continuously, regardless of the ship's location (e.g., in port, at sea, outside Alaska waters).

2.2.4.1 Graywater Treatment System

The graywater treatment system consists of low-pressure reverse osmosis (RO). Wastewaters from accommodations and laundry holding tanks are first treated through SWECO vibrating filters and then through bag filters. Antiscale chemicals are continuously added before the bag filter to keep the membranes clean. Next, the graywater enters the first stage RO membranes. The concentrate (15 percent of graywater treatment system effluent) from the membranes is routed to the graywater/sewage treatment system for further treatment. The graywater permeate (85 percent of graywater treatment system effluent) bypasses the second stage RO membranes, which are not currently operated, and is collected in small permeate tanks (second stage RO membranes are used only in emergency situations and are not shown in Figure 2-4). Sodium hydroxide is added to the permeate to control pH. In the final stage of treatment, the membrane permeate undergoes UV disinfection.

2.2.4.2 Graywater/Sewage Treatment System

The graywater/sewage treatment system consists of biological treatment and low-pressure reverse osmosis. Galley wastewater, graywater treatment system membrane concentrate, and sewage are mixed and passed through one of two SWECO vibrating filters (one operating and one on standby). Filtered wastewater collects in a filtrate tank, where sodium hydroxide is added to control pH. Next, wastewater enters a two-stage bioreactor, where blowers introduce air. The wastewater is then pumped to the RO membranes. Membrane permeate collects in small permeate tanks from which it is pumped to UV disinfection as the final stage of treatment.

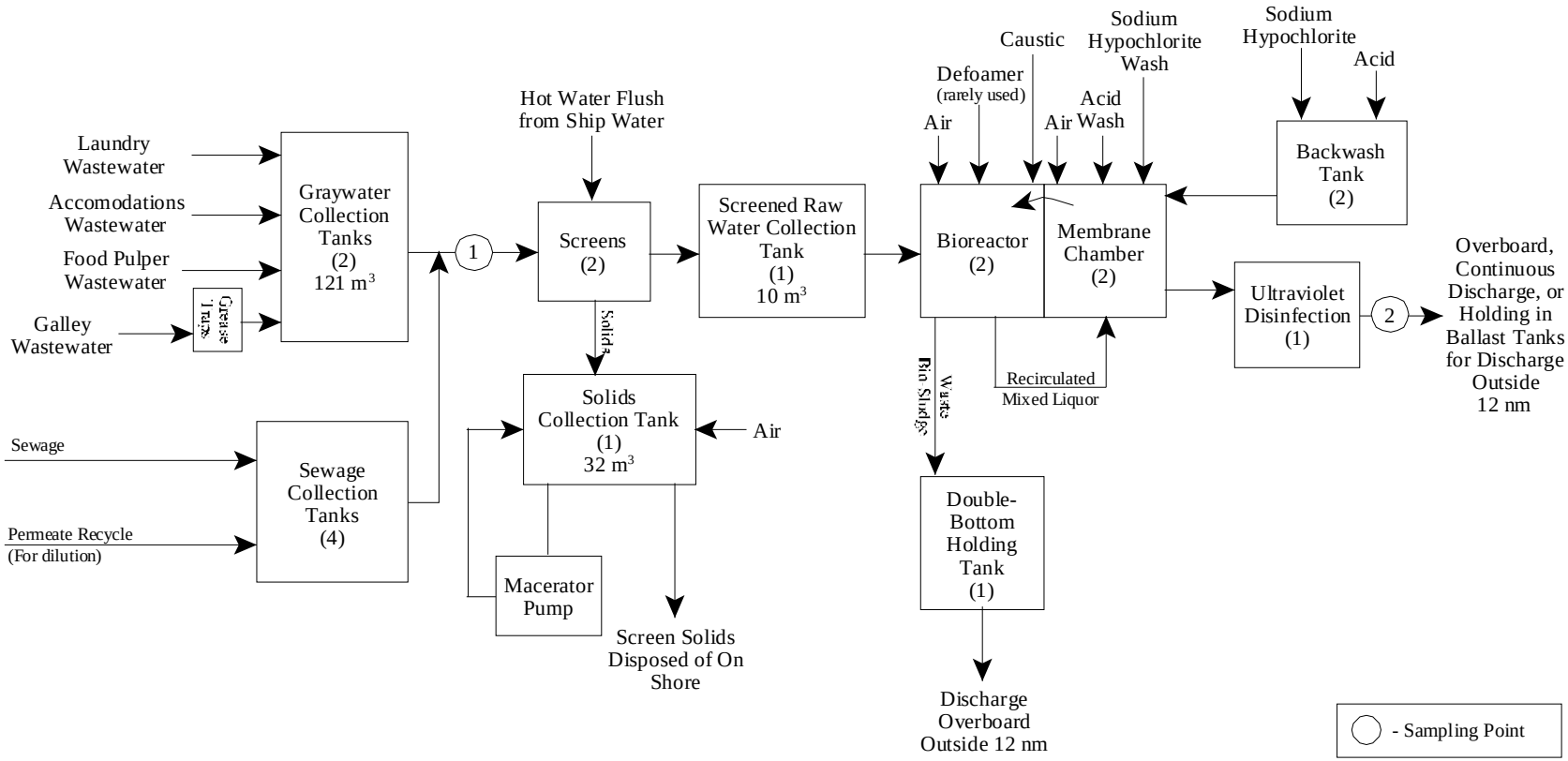

Figure 2-1. Zenon Treatment System – Holland America Veendam

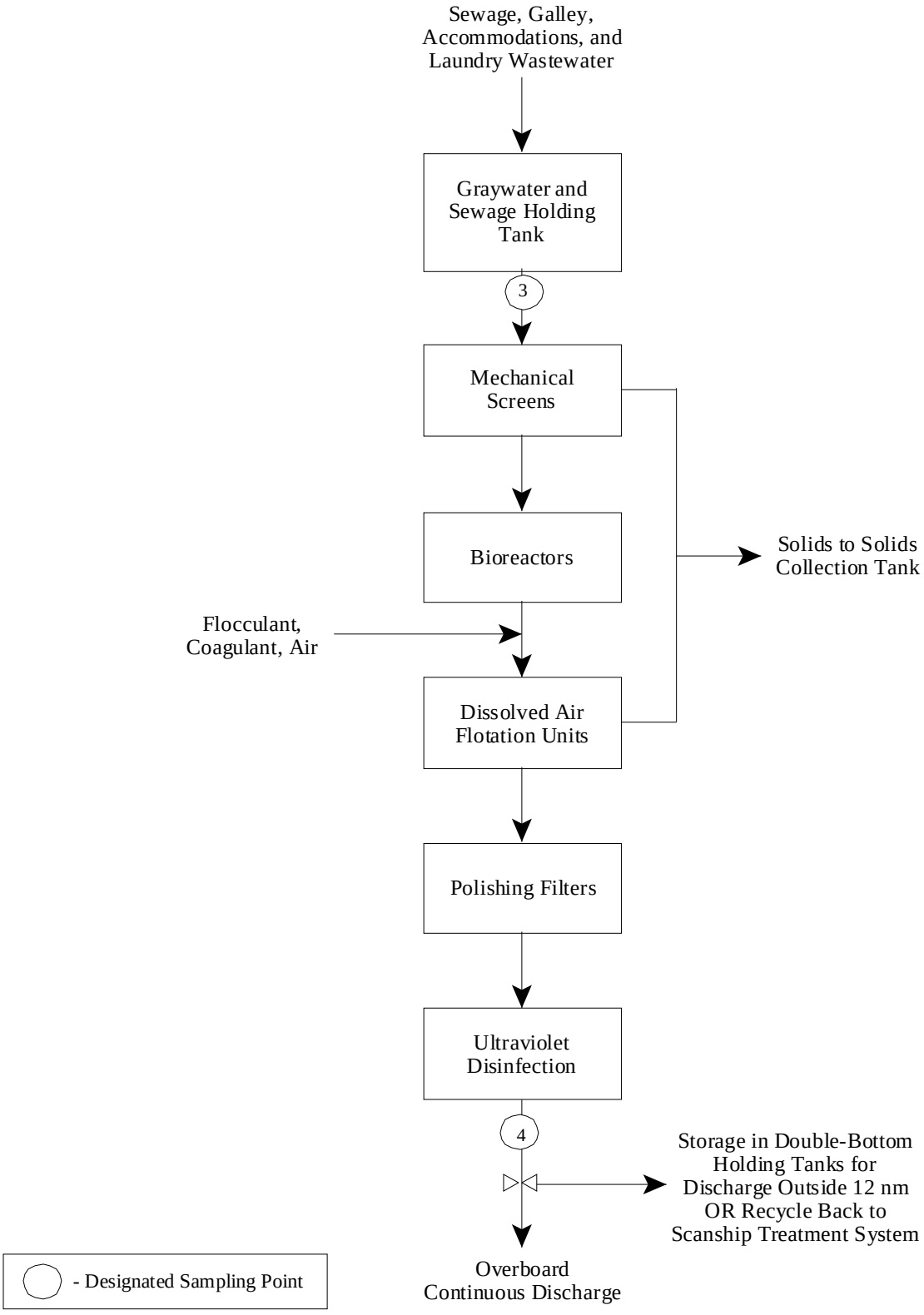

Figure 2-2. Scanship Treatment System – Norwegian Star

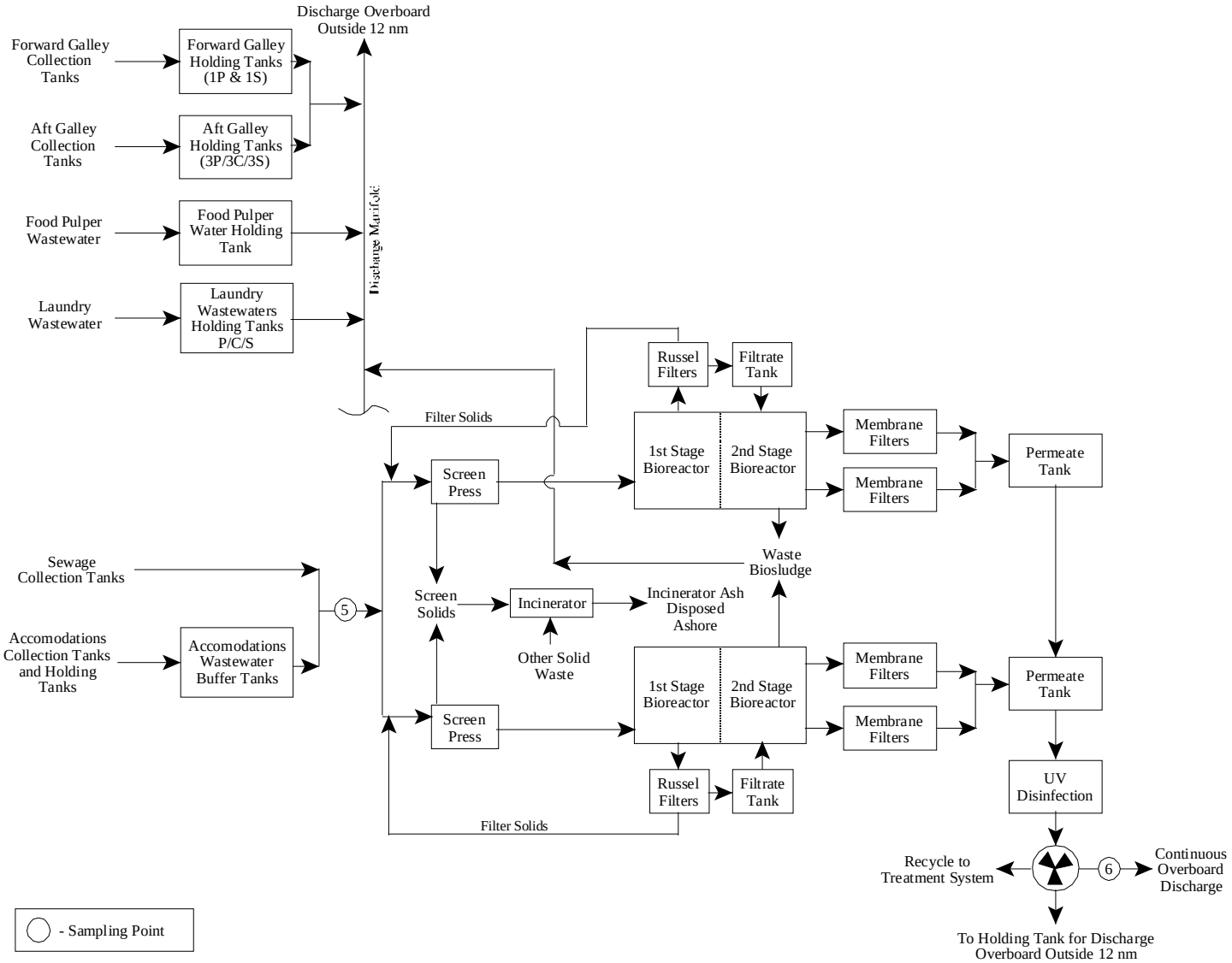

Figure 2-3. Hamworthy Treatment System – Island Princess

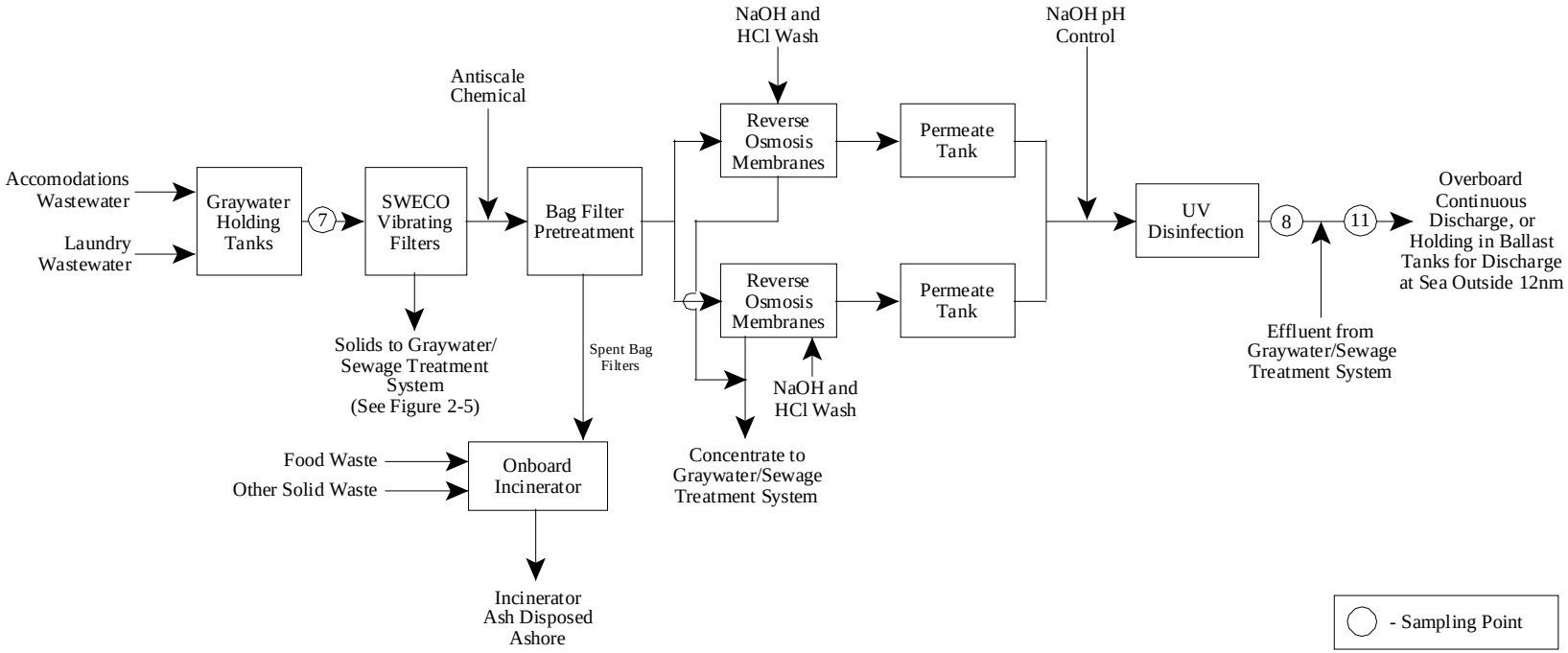

Figure 2-4. Rochem Graywater Treatment System – Holland America Oosterdam

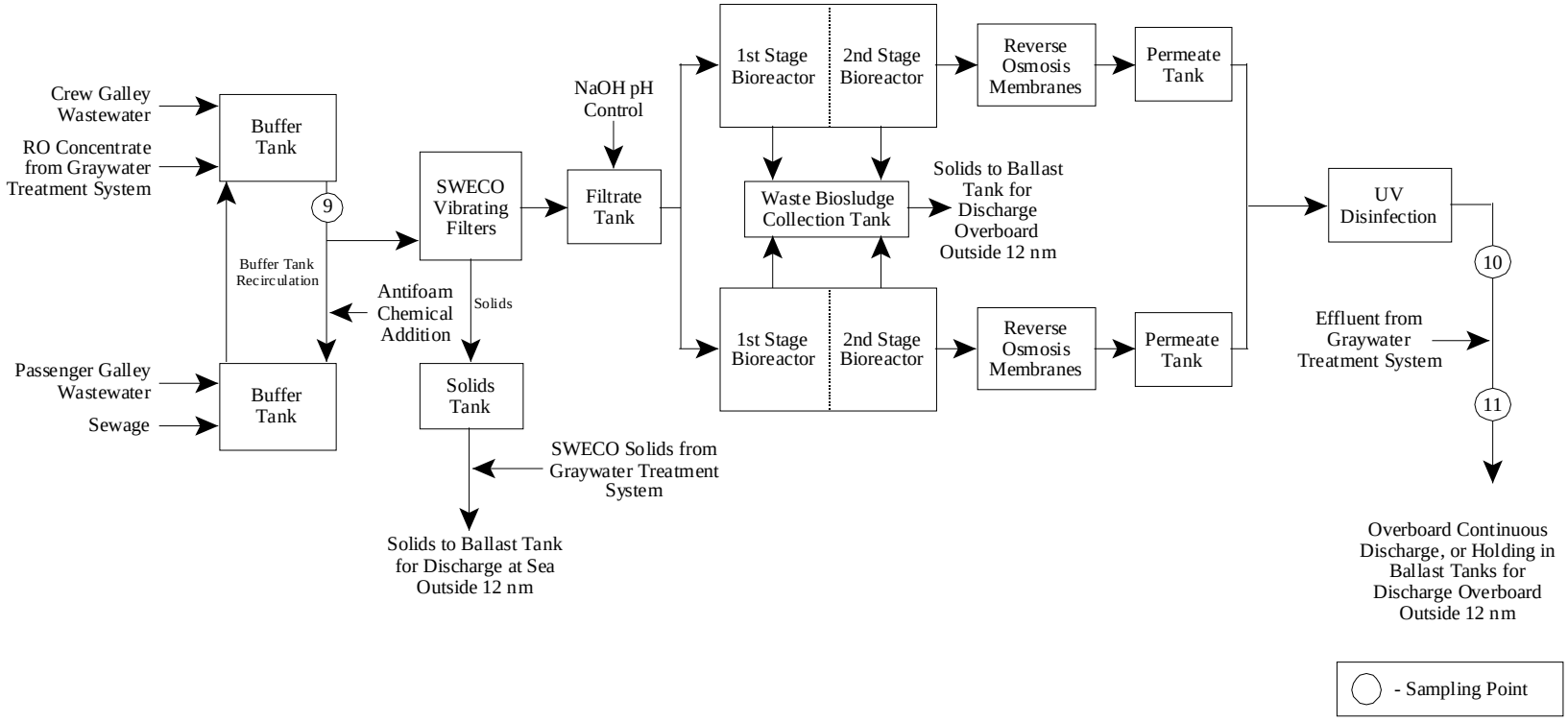

Figure 2-5. Rochem Graywater/Sewage Treatment System – Holland America Oosterdam

3.0 SAMPLING APPROACH

This section contains detailed information regarding specific sampling points and locations, sampling methodologies, analytes, sampling frequency and duration, schedule, and logistics for sampling onboard the Veendam, Star, Island, and Oosterdam. The sampling episode numbers are assigned as follows:

- Veendam - Sampling Episode 6517;
- Star - Sampling Episode 6518;
- Island - Sampling Episode 6519; and
- Oosterdam - Sampling Episode 6520.

3.1 Sampling Point Selection

Figures 2-1 through 2-5 show the planned influent to and effluent from wastewater treatment sampling points. Brief descriptions of what each sampling point will characterize are presented below:

- SP-1 Veendam - Influent to Zenon treatment;
- SP-2 Veendam - Effluent from Zenon treatment;
- SP-3 Star - Influent to Scanship treatment;
- SP-4 Star - Effluent from Scanship treatment;
- SP-5 Island - Influent to Hamworthy treatment;
- SP-6 Island - Effluent from Hamworthy treatment;
- SP-7 Oosterdam - Influent to Rochem graywater treatment;
- SP-8 Oosterdam - Effluent from Rochem graywater treatment;
- SP-9 Oosterdam - Influent to Rochem graywater/sewage treatment;
- SP-10 Oosterdam - Effluent from Rochem graywater/sewage treatment; and
- SP-11 Oosterdam - Final Combined Overboard Discharge.

3.2 Analyte Selection

Analytes included in this sampling program are:

- Nitrogen compounds (ammonia as nitrogen; TKN; and nitrate/nitrite);
- Chemical oxygen demand (COD); and
- Total suspended solids (TSS).

Nitrogen compounds will be analyzed to characterize these parameters in cruise ship wastewater as discussed in Section 1.1. COD and TSS will be analyzed to benchmark wastewater pollutant concentrations and treatment performance to those measured during the 2004 Alaska cruise season.

Table 3-4 lists analyte and pollutant parameters along with their analytical method numbers and laboratory measurement techniques. Nitrogen compounds, COD, and TSS will be analyzed for all samples at all sampling points.

In addition to these analytes, the sampling team will conduct field measurements for ammonia, temperature, and pH at all sampling points.

3.3 Sample Collection

Much of the information about the collection of samples for this sampling program is summarized in a series of tables as follows:

- Table 3-1 lists the sampling points, number of samples to be collected, and parameters for analysis;
- Table 3-2 lists the sample container and preservation for each parameter that will be analyzed; and
- Table 3-3 lists sampling locations and the sample collection type.

3.3.1 Nitrogen Compounds, COD, and TSS

The sampling team will collect one sample from each sampling point each week for five consecutive weeks for nitrogen compounds, COD, and TSS analyses. For the Veendam, Star, and Island, this results in a total of 10 samples for each ship. The sampling team will collect a total of 25 samples for the Oosterdam because this ship has five sampling points (influent and effluent from two treatment systems, plus the final combined overboard discharge). A total of 55 samples (excluding QC samples) will be collected for analysis of these pollutant parameters for the entire sampling program.

Each ship's cruise itinerary includes a port call to Juneau each week (see Appendix A for ship schedule), at which time the sampling team will collect weekly samples. The sampling team will collect samples as grab composite samples (i.e., four grab samples collected over the period of time that the cruise ship is in port). Specifically, the sampling team will fill approximately one-fourth of the sample container when they collect each grab sample, resulting in full sample container at the end of each sampling period; this sampling methodology results in a single analysis for each sampling period. The sample container will typically be a 1-liter plastic bottle. For those sampling periods when additional sample volume is required (see Section 3.2.2) a 1-gallon cubitainer will be used. Sample containers will be filled directly from the sample taps.

To facilitate collection of approximately equal grab samples, the sampling team will mark the liquid levels of the intended grab samples on the exteriors of the sample containers. The liquid level markings will be copied from those on a "template" container that will be determined using a graduated cylinder.

Each sampling period will be approximately 7 hours, beginning as soon as possible when the cruise ships arrive in port (i.e., upon receipt of clearance for boarding). This sampling period was determined based on the shortest duration that any of the cruise ships is in Juneau during the sampling program (i.e., the Norwegian Star with port calls of 8 hours every Tuesday). The sampling team will collect grab samples over equal sampling intervals to the extent possible. For example, the Norwegian Star is in Juneau each Tuesday from 2 pm until 10

pm. The sampling team will collect the first grab sample as soon as possible after they are cleared for boarding (e.g., 2:30 pm). They would collect the final grab sample as close to the required disembarking time as reasonable (e.g., 9:30 pm). The remaining two grab samples would be collected at equal sampling intervals within the sampling period (e.g., two hour and 20 minute intervals, or 4:50 pm and 7:10 pm). As another example, the Veendam is in Juneau on alternate Wednesdays from 7 am until 9:30 pm. The sampling team would collect the first grab sample at 7:30 am, the final grab sample at 2:30 pm, and the remaining two grab samples at 9:50 am and 12:10 pm.

Sample containers will not require rinsing with sample. Samplers will take care not to touch the insides of bottles or lids/caps during sampling. The grab composite samples will be maintained in an ice-water bath to 4°C during the composite period and transport to the laboratory in Juneau for analysis.

The sampling team will complete field sampling log sheets (Figure 3-1) at each sampling point, documenting the grab samples and the grab composite sampling period. This sheet will record the sampling methodology, names of the samplers, sample collection times, field measurements (see Section 3.5), and any notes and observations.

It is important to note that this planned sampling methodology differs from that used during the 2004 sampling program. For that program, 24-hour composite samples were collected over five consecutive days, and the resulting samples represented all ship operating conditions (e.g., day versus night, in port versus at sea). In addition, the composite samples for the 2004 sampling program were also more representative of the waste streams sampled because they were flow-weighted composite samples; grab samples were automatically collected each time a fixed quantity of wastewater passed through the wastewater pipe, resulting in a composite sample consisting of a total of 75 to 150 grab samples per 24-hour composite period.

The planned 2005 sampling methodology may result in samples less representative of untreated and treated wastewater than the 2004 sampling methodology. However, EPA believes the samples will be sufficiently representative to meet the needs of this program for three reasons. First, while the waste streams sampled in 2004 were variable, EPA

did not identify significant differences in wastewater characteristics depending on whether the vessels were at sea versus in port. Second, EPA did not identify significant differences in wastewater characteristics depending on time of day, based on a comparison of the results of microbiologicals grab samples collected at night versus those collected during the day. Third, the wastewater flow profile for the influent to and effluent from treatment is relatively constant, particularly during daytime hours, due to continuous graywater and sewage generation throughout the ship and the wastewater holding time (equalization) provided by the CHT and wastewater treatment systems. The analyses that support these conclusions will be included in the Cruise Ship Rulemaking Record.

3.3.2 Quality Assessment Samples

Duplicate samples will be collected as part of the quality assurance program for this sampling program. The sampling team will collect one field duplicate from each of the treated effluent sampling points (SP-2, SP-4, SP-6, SP-8, SP-10, and SP-11) to satisfy the minimum 10 percent duplicate requirement.

The samplers will collect duplicate samples in a large sample container (e.g., 1-gallon cubitainer) using the same methodology as described above (i.e., one-quarter of the container will be filled each time a grab sample is collected, resulting in a full container at the end of the composite period). The sample container will then be capped, repeatedly inverted to thoroughly mix the contents, and transported to the laboratory where the sample will be split to fill the original and duplicate sample containers from the larger sample container. Results of the duplicate analyses will be used to evaluate precision, including variability in handling, preparation, and analysis.

As part of standard laboratory quality control (QC), matrix effects on analytical performance will be assessed through the analysis of matrix spikes and matrix spike duplicates. The matrix effects will be assessed on the same effluent samples as the duplicate samples (i.e., the sampling container will be large enough to collect sufficient sample volume for the original, duplicate, matrix spike, and matrix spike duplicate samples). Additional matrix spike and matrix spike duplicate samples will also be collected from both influent to and effluent from treatment

system sampling points from three ships (Star, Island, and Veendam) during the first week of sampling to provide detailed information on matrix effects at the start of the sampling program.

Blanks will be prepared for the various sample containers and bottles used for this program to monitor any contamination from the sample containers. Specifically, two bottle blanks will be prepared for the 1-liter sample containers and one bottle blank for the 1-gallon cubitainer. Bottle blanks will be prepared by filling the containers with deionized water, storing the containers for 24-hours, and then transporting the containers to the laboratory for analysis of nitrogen compounds.

3.4 Preservation and Shipping

The sampling team will maintain all samples on ice immediately upon collection, throughout the composite sampling period, and during transport of the samples by automobile to the analytical laboratory in Juneau, Alaska. The samples will arrive at the laboratory within a few hours of sample collection and will be chemically preserved as appropriate upon receipt. Table 3-2 lists the analytical fraction type, sample container, sample volume, and preservation method for each type of analysis.

3.5 Field Measurements

Each time the sampling team collects a grab sample, they will also collect a separate aliquot for field measurements of temperature, pH, and ammonia. The sampling team will conduct these field measurements of the sampling aliquot immediately at the sampling point using a digital thermometer, digital pH meter, and ammonium test strips. Field measurements will be used as general indicators of waste stream characteristics and variability. Ammonia test strip results will also be used to inform the analytical laboratory of expected ammonia concentrations. The ammonia test strips measure ammonia concentrations ranging from 0 mg/L to 400 mg/L.

The samplers will calibrate the pH meter each week using the meter calibration procedures specified by the manufacturer. The samplers will periodically verify calibration of the digital thermometer using the Juneau laboratory NIFT thermometer.

3.6 Sample Labeling

The samplers will code each sample with a unique sample number and attach a pre-printed label at the time of collection. The self-adhesive label will be completed in indelible ink and will contain the following information:

- Sample number;
- Sampling episode number;
- Sampling point/description;
- Sampling point;
- Analysis to be performed;
- Sample bottle type;
- Date of sample collection; and
- Required preservation.

If any of the pre-printed information is incorrect, the samplers will correct it using indelible ink. Once applied to the sample container, labels will be covered with clear tape to prevent tampering, abrasion, smearing, or loss during transit.

3.7 Sample Custody Record

Sample custody will be maintained by the sampling team from sample collection through transport to the laboratory. To maintain a record of sample collection, shipment, and receipt by the laboratory, the sampling team will complete a Traffic Report for each batch of samples transported to the laboratory for each ship. These forms will be completed and used to document sample custody transfer from the field to the laboratory. The samplers will send a copy of the traffic report to the contractor, keep another copy, and send the remainder of the copies with the samples to the analytical laboratory. Figure 3-2 includes an example Traffic Report.

When the samples are received by the designated analytical laboratory, the laboratory will send a copy of the traffic report to the contractor to acknowledge receipt and the condition of the samples.

3.8 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) procedures applicable to this sampling episode are outlined in the *Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Waters* (2) and in the *Addendum to the Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Waters* (3). The QA/QC program for sample collection onboard large cruise vessels will include the following:

- Documentation of sample custody using Traffic Reports; and
- Collection of field duplicate samples.

3.9 Sample Splitting

The cruise lines have the option to collect duplicate samples (split samples) at each of the sampling points. If they exercise this option, the owner of the cruise vessel or their representative will supply all of the personnel, equipment, glassware, and reagents required to collect the split samples and to coordinate the analysis of samples. At this time, none of the cruise line representatives have indicated a desire to collect split samples.

Table 3-1. Samples for Collection Onboard Veendam, Star, Island, and Oosterdam

Sampling Point Number	Sampling Point Name	Number of Samples (a)	
		Nitrogen Compounds (b)	COD and TSS
SP-1	Veendam - Influent to Zenon Treatment	5	5
SP-2	Veendam - Effluent from Zenon Treatment	5	5
SP-3	Star - Influent to Scanship Treatment	5	5
SP-4	Star - Effluent from Scanship Treatment	5	5
SP-5	Island - Influent to Hamworthy Treatment	5	5
SP-6	Island - Effluent from Hamworthy Treatment	5	5
SP-7	Oosterdam - Influent to Rochem Graywater Treatment	5	5
SP-8	Oosterdam - Effluent from Rochem Graywater Treatment	5	5
SP-9	Oosterdam - Influent to Rochem Graywater/Sewage Treatment	5	5
SP-10	Oosterdam - Effluent from Rochem Graywater/Sewage Treatment	5	5
SP-11	Oosterdam - Final Combined Overboard Discharge	5	5
SP-12	Bottle Blanks	3	
Total Number of Samples (Excluding QC) (c)		**58**	**55**

(a) One sample for nitrogen compounds, COD, and TSS analyses will be collected from each sampling point per week for five weeks for a total of five samples per sampling point.
(b) Nitrogen compounds include ammonia as nitrogen, total Kjeldahl nitrogen (TKN), and nitrate/nitrite.
(c) QC samples include 6 duplicate samples and 11 samples for matrix spike/matrix spike duplicates. One of each type of QC sample will be collected from each treated effluent sampling point – SP-2, SP-4, SP-6, SP-8, SP-10, and SP-11. Additional matrix spike/matrix spike duplicate samples will also be collected from the following sampling points during the first week of sampling: SP-1, SP-2, SP-3, SP-5, and SP-6.

Table 3-2. Summary of Sample Container and Preservation Requirements

Parameter	Sample Container	Preservation
Ammonia as Nitrogen, TKN, Nitrate/Nitrite, COD, and TSS (a)	1-L plastic bottle	H_2SO_4 to pH of <2, 4°C (b)

(a) All five tests will be conducted from a single 1-L sample container.
(b) The laboratory will split the sample for analysis upon receipt and prior to performing chemical preservation. The split sample volume for TSS analysis does not require preservation with sulfuric acid.

Table 3-3. Summary of Sampling Locations and Sample Collection Types for Veendam, Star, Island, and Oosterdam

Sampling Point Number	Sampling Point Description	Sampling Location	Sample Collection Type
SP-1	Veendam - Influent to Zenon Treatment Combined wastewaters from the graywater and sewage CHT systems. The graywater CHT system conveys laundry, accommodations, food pulper, and galley wastewater, while the sewage CHT system conveys sewage. Graywater and sewage CHT systems are described in Section 2.1.	Graywater CHT system culminates in two graywater storage tanks, and the sewage CHT system culminates in four sewage collection tanks. Wastewater from the graywater storage tanks and sewage collection tanks mixes in a common line as it flows to the treatment system. Sample tap is installed on the combined graywater and sewage inlet pipe to the screen filters.	Grab composite samples as described in Section 3.3.
SP-2	Veendam - Effluent from Zenon Treatment Final treated graywater and sewage effluent from the Zenon wastewater treatment system. Effluent is continuously discharged overboard, except where prohibited.	Sample tap is installed on the effluent pipe from UV disinfection, upstream of the diversion valve that directs wastewater to either overboard discharge or to storage in double-bottom holding tanks.	Grab composite samples as described in Section 3.3.
SP-3	Star - Influent to Scanship Treatment Combined wastewaters from the graywater and sewage CHT systems (excluding food pulper wastewater, which is discharged without treatment). The graywater CHT system conveys laundry, accommodations, and galley wastewater (described above), while the sewage CHT system conveys sewage. Graywater and sewage CHT systems are described in Section 2.1.	Sewage and graywater combine in the graywater and sewage holding tank, which is the first component of the Scanship treatment system. Sample tap is installed on outlet pipe from the graywater and sewage holding tank (inlet pipe to the drum filters).	Grab composite samples as described in Section 3.3.
SP-4	Star - Effluent from Scanship Treatment Final treated graywater and sewage effluent from the Scanship wastewater treatment system. Effluent is continuously discharged overboard, except where prohibited.	Sample tap is installed on the overboard discharge pipe following UV disinfection.	Grab composite samples as described in Section 3.3.
SP-5	Island - Influent to Hamworthy Treatment Combined wastewaters from the accommodations and sewage CHT systems. Accommodations and sewage CHT systems are described in Section 2.1.	Wastewater from the accommodations wastewater buffer tanks and sewage collection tanks mixes in a common line as it flows to the treatment system. Sample tap is installed on the combined accommodations wastewater and sewage inlet pipe to the screen presses.	Grab composite samples as described in Section 3.3.
SP-6	Inland - Effluent to Hamworthy Treatment Final treated graywater and sewage effluent from the Hamworthy wastewater treatment system. Effluent is continuously discharged overboard, except where prohibited.	Sample tap is installed on the effluent pipe from the UV disinfection, downstream of the diversion valve that directs wastewater to either overboard discharge or to storage in double-bottom holding tanks.	Grab composite samples as described in Section 3.3.
SP-7	Oosterdam - Influent to Rochem Graywater Treatment Combined wastewaters from the accommodations and laundry CHT systems. Accommodations and laundry CHT systems are described in Section 2.1.	The laundry and accommodations CHT systems culminate in the graywater storage tanks. Sample tap is installed on the piping from the graywater holding tanks to the SWECO vibrating filters.	Grab composite samples as described in Section 3.3.

Table 3-3 (Continued)

Sampling Point Number	Sampling Point Description	Sampling Location	Sample Collection Type
SP-8	Oosterdam - Effluent from Rochem Graywater Treatment Final treated graywater effluent from the Rochem graywater treatment system. Effluent is combined with effluent from the Rochem graywater/sewage treatment system and continuously discharged overboard, except where prohibited.	Sample tap is installed on the effluent pipe from the graywater UV disinfection unit, upstream of where the Rochem graywater effluent is mixed with Rochem graywater/sewage effluent for overboard discharge.	Grab composite samples as described in Section 3.3.
SP-9	Oosterdam - Influent to Rochem Graywater/Sewage Treatment Combined wastewaters from the galley and sewage CHT systems, plus reverse osmosis concentration from the Rochem graywater treatment system. Galley and sewage CHT systems are described in Section 2.1.	Crew galley wastewater and Rochem graywater treatment system concentrate are combined in one buffer tank, while passenger galley wastewater and sewage are combined in a second buffer tank. Buffer tanks are continuously recirculated back and forth to mix their contents, and the wastewater feed to the Rochecm graywater/sewage treatment system is from this recirculation loop. Sample tap is installed on the buffer tank recirculation loop.	Grab composite samples as described in Section 3.3.
SP-10	Oosterdam - Effluent from Rochem Graywater/Sewage Treatment Final treated graywater and sewage effluent from the Rochem graywater/sewage treatment system. Effluent is combined with effluent from the Rochem graywater treatment system and continuously discharged overboard, except where prohibited.	Sample tap is installed on the outlet pipe from the graywater/sewage UV disinfection unit, upstream of where the Rochem graywater/sewage effluent is mixed with Rochem graywater effluent for overboard discharge.	Grab composite samples as described in Section 3.3.
SP-11	Oosterdam - Final Combined Overboard Discharge Final combined treated effluent discharges from the Rochem graywater and graywater/sewage Treatment Systems. Combined final effluent is continuously discharged overboard, except where prohibited.	Sample tap is installed on the overboard discharge line, downstream of where Rochem graywater and graywater/sewage effluents are combined.	Grab composite samples as described in Section 3.3.

Table 3-4. Standard Analytical Methods and Procedures

Method No.	Title	Method Type
EPA 350.1, 350.2, or 350.3	Ammonia as Nitrogen	Colorimetric, Titrimetric, or Potentiometric The laboratory will use Method 350.3 (ion selective electrode) for determinative analysis. Sample preparation using the distillation procedure in Method 350.2 is not indicated by Method 350.3 and will not be performed. The laboratory may confirm sample concentrations using Method 350.1 at their discretion and in consultation with the contractor (i.e., samples with ammonia concentrations that exceed TKN concentrations or other anomalous results).
351.3	Total Kjeldahl Nitrogen (TKN)	Colorimetric, Titrimetric, or Potentiometric
300.0	Nitrate/Nitrate (Combined)	Ion Chromatography
410.4	Chemical Oxygen Demand (COD)	Colorimetric
160.2	Total Suspended Solids	Gravimetric

Date: _____

Sampling Episode:

Sampling Point:

Sample Number:

Time of Compositing period, if applicable:

Start Time _____ ☐ AM ☐ PM

End Time _____ ☐ AM ☐ PM

Equipment Used:

Samplers' Names: _____

Grab Sample	Time	Temp °C	pH	Ammonia (mg/L)
1				
2				
3				
4				

Notes: (include observations of odor and color of each aliquot, take pictures if necessary)

_____

_____

_____

_____

_____

_____

Figure 3-1. Field Sampling Log Sheet

EPA

United States
Environmental Protection Agency
Washington, DC 20460

EPISODE NO:

RANGE OF SAMPLE NOS:

TRAFFIC REPORT
USEPA ENGINEERING AND ANALYSIS DIVISION
SAMPLE CONTROL CENTER

Return completed form to:
P.O. BOX 1407
ALEXANDRIA, VA 22313
(703) 519-1140

INDUSTRIAL FIRM SAMPLED	SHIPPING & INFORMATION
NAME:	SHIP TO:
CITY:	ATTN:
STATE:	CARRIER:
INDUSTRIAL CATEGORY:	AIRBILL:
	DATE SHIPPED:
CONFIDENTIAL (Y/N):	SAMPLING OFFICE/SAMPLER:

SAMPLE POINT DESCRIPTION											SAMPLE ANALYSES						
SAMPLE NUMBER	SOURCE WATER (city, river, well)	IN LINE PROCESS	UNREATED EFFLUENT (raw wastewater)	TREATED EFFLUENT	OTHER (specify)	ADDITIONAL SAMPLE DESCRIPTION	PH LEVEL	PRESERVED (Y/N)	G=GRAB / C=COMPOSITE	SAMPLE COLLECTION TIME / DATE							

Comments:

EPA Form 7500-50 (Rev 6-94) Previous editions are obselete.
Page 1: SCC Copy
Copy of Page 1: Sampler Copy
Page 2: Lab Copy
Copy of Page 2: Lab Copy for return to SCC

Figure 3-2. Example Traffic Report

4.0 SAMPLING ACTIVITIES

This section discusses the sampling team organization, ship visit preparation, and sampling activities.

4.1 Sampling Team Organization

The sampling team will consist of laboratory analytical contractors. The sampling team leader will be responsible for all sample collection, preservation, and shipping activities onboard. After completion of the sampling episodes, the contractor will collate the results and summarize and transmit this information, along with a trip report, to EPA. After EPA review, the report will be forwarded to the cruise lines for their review.

4.2 Pre-Visit Preparation

As a part of preparing the team for the sampling program, the sampling team leader will distribute this sampling and analysis plan to each sampling team member and ensure that they are completely familiar with the sampling requirements. Cruise vessel personnel will also be given copies of this sampling and analysis plan prior to the start of sampling. The sampling team leader will coordinate the procurement of all necessary sampling equipment.

During the week prior to the start of the sampling program, the sampling team leader will conduct visits to each of the four ships to establish ship contacts, communications, and safety and emergency procedures, and to inspect installation of required sampling ports and associated fittings. If conditions exist that are different from those experienced during the 2004 sampling program, the sampling team will make modifications in consultation with the contractor Project Manager and EPA personnel.

Sampling team members will attend health and safety briefings lead by each ship's Environmental Officer at his/her discretion.

4.3 Field Sampling Activities

Appendix A is a schedule of the sampling activities; the sampling team will verify actual ship arrival and departure times each day. The sampling team will label, seal, and place sample containers in coolers for transport directly to the laboratory by car. The sampling team will complete and place the Traffic Report forms inside the coolers, and transport the coolers to the analytical contractor's Juneau laboratory. The sampling team leader will contact the contractor's Project Manager before and after sampling each week to confirm the sampling schedule and the number of samples being collected and to verify successful transport of the samples to the analytical laboratory.

4.4 Logistics

This section of the sampling plan summarizes cruise vessel contacts, analytical laboratory contacts and addresses, and sampling team personnel and support functions.

Cruise Line Contacts

Nick Schowengerdt
Director of Environment
Holland America Cruise Lines
(206) 298-3067

Randall R. Fiebrandt. P.E.
Director, Environmental Operations
Norwegian Cruise Line/Orient Lines
7665 Corporate Center Dr.
Miami, FL 33126
(305) 436-4956

George Wright
Vice President Environmental Compliance
Princess Cruises
(661) 753-2747

EPA Contacts

Don Anderson
Engineering and Analysis Division
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Mail Code 4303T
Washington, D.C. 20460
(202) 566-1021

Elizabeth Kim
Office of Wetlands, Oceans, and Watersheds
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Mail Code 4504T
Washington, D.C. 20460
(202) 566-1270

Analytical Laboratory

Analytica Alaska, Inc.
5438 Shaune Drive
Juneau, AK 99801
(907) 780-6668
Contact: Sally Wanstall

ERG Contact

Debra Falatko (Project Manager)
Eastern Research Group, Inc.
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(703) 633-1607

Admiralty Environmental Contact

David Wetzel (Sampling Team Leader)
Admiralty Environmental, LLC
175 S. Franklin St., Suite 328
Juneau, AK 99801
(907) 463-4415
(907) 723-4415 (cell)

5.0 REFERENCES

1. Tchobanoglous, G. and T. Burton, eds. Metcalf & Eddy, *Wastewater Engineering*, Third Edition, 1991.

2. Eastern Research Group, Inc. *Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Water*. Prepared for U.S. Environmental Protection Agency. December 2004.

3. Eastern Research Group, Inc. *Addendum to the Quality Assurance Project Plan for Rulemaking Support for Large Cruise Ships in Alaska Water*. Prepared for U.S. Environmental Protection Agency. July 2005.

Appendix A

CRUISE VESSEL AND SAMPLING SCHEDULE

2005 Alaska Cruise Schedule for Juneau

Veendam: In Juneau on **alternating Wednesdays and Thursdays**. Wednesdays include: 7/6/05, 7/20/05, 8/3/05, 8/17/05, and 8/31/05, each day from 0700 until 2130. Thursdays include 7/14/05, 7/28/05, 8/11/05, 8/25/05, and 9/8/05, each day from 0800 until 1800. Thursday 9/8/05 is the Veendam's last port call in Juneau for the 2005 cruise season.

Star: In Juneau on **Tuesdays** from 1400 until 2200. Tuesday 9/13/05 is the Star's last port call in Juneau for the 2005 cruise season.

Island: In Juneau on **alternating Tuesdays and Wednesdays**. Tuesdays include: 7/5/05, 7/19/05, 8/2/05, 8/16/05, and 8/30/05, each day from 0700 until 1930. Wednesdays include 7/13/05, 7/27/05, 8/10/05, 8/24/05, and 9/7/05, each day from 0630 until 1600. Wednesday 9/7/05 is the Island's last port call in Juneau for the 2005 cruise season.

Oosterdam: In Juneau on **Mondays** from 1100 until 2000; one exception is Monday 8/1/05, when the ship will be in Juneau from 1300 until 2200. Monday 9/19/05 is the Oosterdam's last port call in Juneau for the 2005 cruise season.

2005 Sampling Schedule

Sampling Week	Monday	Tuesday	Wednesday	Thursday
1 (Week of 8/1/05)	Oosterdam: 1100 - 2200	Star: 1400 - 2200 Island: 0700 – 2100	Veendam: 0700 - 2130	
2 (Week of 8/8/05)	Oosterdam: 1100 - 2000	Star: 1400 – 2200	Island: 0630 - 1600	Veendam: 0800 - 1800
3 (Week of 8/15/05)	Oosterdam: 1100 - 2000	Star: 1400 - 2200 Island: 0700 – 2100	Veendam: 0700 - 2130	
4 (Week of 8/22/05)	Oosterdam: 1100 - 2000	Star: 1400 – 2200	Island: 0630 - 1600	Veendam: 0800 - 1800
5 (Week of 8/29/05)	Oosterdam: 1100 - 2000	Star: 1400 - 2200 Island: 0700 – 2100	Veendam: 0700 - 2130	