

## 2004 Small Ship Wastewater Sampling Results

Alaska Statute (AS) 46.03.460-46.03.490 establishes the Commercial Passenger Vessel Environmental Compliance Program (CPVEC), which is administered by the Alaska Department of Conservation (ADEC) and applies to large<sup>1</sup> and small<sup>2</sup> commercial passenger vessels. The law requires small vessels to sample their wastewater discharges twice per season. Several key aspects of the CPVEC program, such as payment of environmental compliance fees and compliance with wastewater discharge standards, became effective for small commercial passenger vessels on January 1, 2004.

Small cruise ships are now required to meet standard terms and conditions, or seek alternative terms and conditions, in order to discharge blackwater<sup>3</sup> and graywater<sup>4</sup> in Alaska marine waters. Under standard terms and conditions, blackwater, graywater and other wastewater must contain no more than 200 fecal coliform per 100 milliliters and no more than 150 milligrams per liter of total suspended solids.

In 2004, most small vessels and ferries sought alternative terms and conditions under an Interim Protective Measures (IPM) Plan because the effluent from the treatment systems on board does not meet standard terms and conditions and advanced treatment systems installed on large ships are not yet commercially available to small vessels.

Nineteen small ships registered with the CPVEC program in 2004, including five state ferries that operate in Alaska year-round. Four of the small ships did not report wastewater sampling results: one canceled its Alaska itineraries, one did not discharge into Alaska water and did not need to sample under state law, one hit a rock early in the season and was out of service for the remainder of the year. One small ship operator did not sample its wastewater as required and received a notice of violation and subsequent fine from ADEC.

Table 1 summarizes the 2004 small ship sampling results using the median<sup>5</sup> results for each pollutant. Data from the 15 ships are aggregated. Results show that small-ship effluent does not meet water quality standards at the end of pipe for fecal coliform, chlorine, residual dissolved copper and dissolved selenium.

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<sup>1</sup> A large vessel has >250 overnight passengers as defined in AS 46.03.490(13)

<sup>2</sup> A small vessel has 50-249 overnight passengers as defined in AS 46.03.490(7)

<sup>3</sup> Wastewater from toilets as defined in AS 46.03.490(12).

<sup>4</sup> As defined in AS 46.03.490(6). Wastewater from galley, dishwasher, bath and laundry.

<sup>5</sup> The median is the middle of a distribution: half the scores are above the median and half are below the median. The median is less sensitive to extreme scores than an average and is thus a better measure for skewed distributions.

Table 1. Summary 2004 Small Vessels Median Sampling Results (15 vessels)

	Ammonia as N	pH	Biochemical O <sub>2</sub> Demand, 5 day	Chemical Oxygen Demand	Total Suspended Solids	Free Chlorine, Residual	Fecal Coliform Bacteria by MPN
<b>Alaska Standards</b>	17.0 <sup>6</sup>	6.5-8.5	None	none	150.0	0.0075	200 <sup>7</sup>
<b>Units</b>	Mg/L		Mg/L	Mg/L	Mg/L	Mg/L	MPN/100ml
<b>Graywater (samples=14)</b>	1.20	7.15	156.00	311	63.1	0.0750	1,250
<b>Blackwater (samples=15)</b>	15.00	7.83	47.80	290	38.4	0.0500	16,000
<b>Mixed Blackwater &amp; Graywater Samples=17</b>	9.70	7.24	179.50	580	104.0	0.0500	1,600

Sample Name	Arsenic, dissolved	Chromium, dissolved	Copper, dissolved	Lead, dissolved	Selenium, dissolved	Nickel, dissolved	Zinc, dissolved
<b>Reportable Limit (PQL)</b>	0.5	0.5	0.5	0.5	0.5	0.5	0.5
<b>Alaska Standards</b>	36.0	50.0	3.1	8.1	71.0	8.2	81.0
<b>Units</b>	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
<b>Median (samples=15)</b>	25.7	1.3	26.1	0.3	92.4	6.3	59.6

### Wastewater results for individual ships

Tables 2 through 5 show the 2004 twice-per-season sampling results for each of the 15 ships that reported. Results highlighted in yellow are outside the standard terms and conditions or appropriate water quality standard. The small ships operating under interim protection measures plans do not need to meet standard terms and conditions, so no enforcement action was required.

### Bacteria

The small ships continue to try to balance bacterial disinfection and chlorine use. Chlorine is used to disinfect bacteria, but it is toxic to marine organisms and high residuals must be avoided. The median chlorine residual result is 100 times Alaska's marine water quality standard (AMWQS). The maximum chlorine residual results for small-ship graywater and blackwater were 11 mg/L and 25 mg/L, respectively—more than 1000 times Alaska's marine water quality standard (AMWQS). The fecal coliform standard is 200 colonies per 100 ml to meet AMWQS for secondary-contact recreation. The most stringent AMWQS is 14 colonies per 100 ml to collect shellfish for raw

<sup>6</sup> Ammonia standards are based on temperature, pH and salinity. This standard is from Table IX in the *Alaska Water Quality Criteria Manual for Toxics and Other Deleterious Organic and Inorganic Substances* using a pH of 7.0, salinity of 20 g/kg and temperature of 10-15 degrees Celsius. Large ships while stationary have a minimum dilution factor of 10. Ammonia levels greater than 20 mg/L exceed water quality standards in the receiving water.

<sup>7</sup> The standard in receiving water for consumption of raw shellfish is 14 fecal coliform bacteria per 100 ml. Effluent levels below 200 fc/100ml means that with dilution, the 14 fc/100ml standard will be met in the receiving water.

consumption, and is the standard used to protect all uses of all waters. Blackwater has the highest median fecal coliform results. At 16,000 colonies per 100 ml, the median is more than 1000 times the AMWQS for raw consumption of shellfish. The maximum fecal coliform result was for mixed blackwater and graywater from the Matanuska state ferry. At 197,000,000 colonies per 100 ml, this is 14 million times AMWQS for raw shellfish consumption.

### ***Other Pollutants***

For one of the two samples for each ship, ADEC analyzed 167 "priority pollutants:" 13 total metals, 12 dissolved metals; 72 volatile organic compounds (VOCs); 70 bases, neutral, acids (BNAs). Some small ships have separate graywater and blackwater discharges. The department allowed these ships to sample priority pollutants<sup>8</sup> on one of their wastewater discharges per season.

Most of the priority pollutants were not detected in small ship discharges. Table 5 includes only priority pollutants with medians that exceeded the practical quantitation limit (PQL) or a pollutant with a maximum value 10 times the PQL. Table 5 also does not include total recoverable metals because Alaska uses dissolved metal concentration (a subset of total recoverable metals) for its water quality standards. The pollutants not listed here are considered not detected and the analysis of those pollutants is unnecessary.

Alaska does not currently have marine water quality standards for chloroform, bromoform, methylphenol, chlorophenylmethylsulfone, and benzoic acid. There are Alaska Marine Water Quality Standards (AMWQS) for arsenic, chromium, copper, lead, selenium, nickel and zinc.

With one exception, all small ships met the AMWQS for dissolved arsenic, chromium and lead. The Spirit of Endeavor exceeded the AMWQS for arsenic by 3.6 microgram per liter (ug/L). Most small ships that operated in Alaska in 2004 exceeded the AMWQS for copper, selenium, nickel and zinc.

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<sup>8</sup> The priority pollutants analysis can be found in the Large Ship Unannounced Sampling Report.





Table 4. 2004 Small Ship Unannounced Sampling Blackwater and Graywater Mixed Results (not including priority pollutants)

VESSEL_ID	Sample date	Ammonia as N	pH	BOD	COD	TSS	Chlorine, Residual	Fecal Coliform Bacteria by MPN	Conductivity	Chlorine, Free	Oil & grease	Total Organic Carbon	alkalinity, Total as CaCO3	Total Nitrate & Nitrite as N	Phosphorus, Total	Nitrogen, Total Kjeldahl	Total Settleable Solids
		0.100	0.10	2.00	10	4.0	0.10	2	2	0.10	5.00	1.00	2.0	1.00	0.050	1.00	0.10
		Mg/L	s.u.	mg/L	Mg/L	mg/L	mg/L	MPN/100ml	umhos/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		17.000	6.5-8.5					200		0.0075							
Columbia	6/28	0.870	7.46	470.00	120	667.0	3.10	1	31600	2.4000	2.5	53.00	125.0	3.70	1.200	13.80	80.00
Columbia	8/2	12.000	7.24	95.90	240	73.2	0.05	22	24900	0.0000	2.5	256.00	118.0	0.10	1.600	21.90	0.49
Kennecott	6/22	9.700	7.23	113.00	240	54.2	0.05	1,600	30000	0.0000	2.5	58.00	127.0	6.30	2.100	18.10	3.50
Kennecott	8/3	0.200	7.90	1.00	270	16.2	4.00	76	33900	1.2000	2.5	140.00	84.6	5.30	0.025	1.33	0.25
Malaspina	8/14	17.700	7.10	329.00	490	130.0	0.05	26,000,000	13300	0.0000	Broken Container	107.00	285.0	0.05	6.000	29.40	0.05
Malaspina	9/20	20.200	6.80	230.00	730	145.0	0.05	250	28800	0.0000	6.5	159.00	148.0	10.00	2.800	53.00	2.10
Malaspina	9/20	21.000	6.81	244.00	1200	120.0	0.05	10	28500	0.0000	6.7	408.00	153.0	9.80	3.000	52.60	2.30
Matanuska	6/17	0.050	7.34	Lab error	1600	104.0	0.25	16,000,000	23600	0.1000	2.5	60.00	157.0	5.10	2.300	31.00	0.47
Matanuska	8/12	1.200	6.57	162.00	150	78.0	0.10	197,000,000	19000	0.1000	2.5	268.00	116.0	0.05	1.800	27.20	0.65
Taku	8/13	0.590	8.08	156.00	230	69.1	3.00	35	31500	1.2000	0.0	73.40	91.1	0.00	0.000	8.86	2.50
Taku	9/17	0.800	7.91	58.20	580	93.3	0.05	1	37300	0.8000	Missing	618.00	108.0	6.90	Missing	4.61	1.20
Spirit of Oceanus	6/12	2.040	6.00	178.00	888	26.1	0.05	9,000		0.0000	149.0	140.00	81.0	0.05	8.390	14.50	0.00
Spirit of Oceanus	8/15	0.820	6.72	364.00	600	102.0	0.05	17,000,000	576	0.0000	23.0	95.10	63.3	0.05	3.200	12.70	0.87
Wilderness Adventurer	7/31	14.000	7.90	155.00	110	121.0	2.20	200	32400	0.4000	6.9	59.90	151.0	0.16	3.000	38.00	8.00



Table 5. 2004 Small Ship Sampling Priority Pollutants

VESSEL ID	Sample Date	Sample Name	chloroform	bromoform	Arsenic, dissolved	Chromium, dissolved	Copper, dissolved	Lead, dissolved	Selenium, dissolved	Nickel, dissolved	Zinc, dissolved	3&4- Methylphenol	4- chlorophenyl methylsulfone	Benzoic Acid
		Reportable Limit (PQL)	2.0	2.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	10	260
		Alaska Marine Water Quality Standards	N/A	N/A	36.0	50.0	3.1	8.1	71.0	8.2	81.0	N/A	N/A	N/A
		Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Columbia	8/2	Mixed BW&GW	1.8	69.0	25.8	0.0	62.0	0.0	88.8	4.8	157.0	13.0	0.0	140.0
Kennicott	8/3	Mixed BW&GW	1.0	33.0	32.4	1.3	88.0	0.5	108.0	14.3	157.0	10.5	42.5	275.0
Malaspina	9/20	Mixed BW&GW	7.1	23.0	26.3	2.8	65.4	1.1	102.0	15.3	152.0	72.0	10.0	360.0
Malaspina	9/20	Mixed BW&GW	7.0	21.0	25.5	3.2	64.6	0.6	100.0	15.4	109.0	67.0	10.5	400.0
Matanuska	8/12	Mixed BW&GW	3.4	0.0	18.0	0.0	0.0	0.0	61.9	11.5	0.0	98.0	0.0	350.0
Sea Bird	8/1	Graywater (GW)	19.0	1.0	1.3	1.3	29.7	0.5	1.3	0.5	29.7	2.8	11.0	19.0
Sea Lion	7/31	Blackwater (BW)	0.0	0.0	18.1	0.0	5.4	0.0	90.7	3.8	8.5	0.0	0.0	0.0
Spirit of 98	8/12	Graywater (GW)	6.5	0.0	0.0	0.0	19.7	0.0	0.0	0.0	79.6	2.9	0.0	0.0
Spirit of Alaska	8/23	Graywater (GW)	16.0	0.6	0.0	0.0	71.9	2.3	0.0	3.5	340.0	8.3	10.5	70.0
Spirit of Columbia	8/3	Blackwater (BW)	0.0	0.0	32.4	0.0	0.0	0.0	108.0	0.0	19.2	0.0	0.0	0.0
Spirit of Discovery	8/13	Blackwater (BW)	0.0	0.0	26.1	3.1	4.2	0.0	94.0	5.4	39.5	37.0	0.0	18.0
Spirit of Endeavor	8/18	Blackwater (BW)	0.0	0.0	39.6	3.8	3.6	0.0	136.0	7.3	9.6	450.0	0.0	3200.0
Spirit of Oceanus	8/15	Mixed BW&GW	0.0	9.3	0.0	0.0	106.0	2.0	3.7	3.9	269.0	0.0	0.0	42.0
Taku	9/17	Mixed BW&GW	0.0	200.0	35.2	2.61	22.4	4.62	127.0	7.32	7.32	0.0	0.0	0.0
Wilderness Adventurer	7/31	Mixed BW&GW	15.0	170.0	34.0	3.6	56.4	0.0	170.0	17.5	357.0	0.0	0.0	0.0
Wilderness Discoverer	9/12	Mixed BW&GW	24.0	1.0	14.9	15.5	3.9	0.5	59.3	16.5	11.3	380.0	105.0	1300.0
		<b>Minimum</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		<b>Maximum</b>	24.0	200.0	39.6	15.5	106.0	4.6	170.0	17.5	357.0	450.0	105.0	3200.0
		<b>Median</b>	2.6	1.0	25.7	1.3	26.1	0.3	92.4	6.3	59.6	9.4	0.0	56.0