Permit No.: 2009DB0026

2010 Large Commercial Passenger Vessel Wastewater Discharge General Permit Information Sheet

April 22, 2010

Alaska Department of Environmental Conservation
Division of Water
Commercial Passenger Vessel Environmental Compliance Program
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The Alaska Department of Environmental Conservation issued a General Permit pursuant to AS 46.03 and 18 AAC 69 for Large Commercial Passenger Vessel Discharges to Marine Waters of the State

The Alaska Department of Environmental Conservation (ADEC), Commercial Passenger Vessel Environmental Compliance (CPVEC) Program issued the 2010 Large Commercial Passenger Vessel Wastewater Discharge General Permit (the 2010 General Permit), number 2009DB0026 for discharges of treated sewage and treated graywater.

The 2010 final General Permit places limits on the types and amounts of pollutants that can be discharged from large commercial passenger vessels and places other conditions on such activity. The 2010 final General Permit only authorizes discharge of waste streams specifically included in this permit. This information document includes:

- information on the final General Permit;
- discussion of significant changes from the 2008 General Permit (2007DB0002);
- discussion of significant changes from the 2010 draft General Permit (2009DB0026) and
- a description of the effluent limits.

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Public Comment

The Department sought public comment on the draft General Permit from January 31, 2010 through March 3, 2010.

The Department also held a combined public information workshop and public hearing at Centennial Hall in Juneau Alaska on February 17, 2010. Interested members of the public provided formal verbal testimony which became part of the administrative record of this permit.

The Department received comments from 27 organizations and individuals on the 2010 draft General Permit. A discussion of some of the changes made from the draft to the final permit as a result of these comments is discussed in this document.

Appeal Procedures

A person adversely affected by the Department's permit decision may request an adjudicatory hearing in accordance with 18 AAC 15.195 - 18 AAC 15.340 or an informal review by the division director in accordance with 18 AAC 15.185.

For more information on the right to an administrative appeal, visit: http://dec.alaska.gov/commish/reviewGuidance.htm

Effluent Limits

The effluent limits in the 2010 General Permit are found in the tables below and are explained in more detail in the parameter-specific sections below. The most significant change from the draft to the final General Permit was to keep effluent limits that apply to all permitted ships in Table 1 and to add Tables 2-7 to the permit for effluent limits that are specific to the type of wastewater treatment system on board. Ships will need to comply with the limits and monitoring requirements in Table 1 and the appropriate Table 2-7, based on the type of wastewater treatment system used.

Table 1: Effluent Limits and Discharge Reporting for all Vessels.

(See tables 2 through 7 for ammonia and metals limits specific to the wastewater treatment system installed on your vessel.)

Parameter	Minimum Value	Monthly Geometric Mean [a]	Daily Maximum	Minimum Frequency	Sample Type
Fecal Coliform Bacteria	N/A	14 per 100 mL	43 per 100 mL	Twice per month	Grab

Parameter	Minimum Value	Monthly Average [b]	Daily Maximum	Minimum Frequency	Sample Type
Total Flow (cubic meters per day of effluent)	N/A	Not to exceed design capacity	Not to exceed design capacity	Daily	Metered or estimated
Biochemical Oxygen Demand (5-day)	N/A	30 mg/L	60 mg/L	Twice per month	Grab
Total Residual Chlorine	N/A	N/A	10 ug/L [c]	Twice per month	Field test
pH	6.5 S.U.	N/A	8.5 S.U.	Twice per month	Field test, grab, or continuous
Total Suspended Solids (TSS)	N/A	N/A	150 mg/L	Twice per month	Grab or Continuous
Specific Conductance	N/A	N/A	Report	Twice per season	Field test, grab, or continuous
Chemical Oxygen Demand	N/A	N/A	Report	Twice per season	Grab
Nitrate-Nitrogen (NO_3 - N)	N/A	N/A	Report	Twice per season	Grab
Total phosphorus	N/A	N/A	Report	Twice per season	Grab
Total Kjeldahl Nitrogen (TKN)	N/A	N/A	Report	Twice per season	Grab
Total Organic Carbon	N/A	N/A	Report	Twice per season	Grab
Base-Neutral Acid extractables (BNA) [d]	N/A	N/A	Report	Twice per season	Grab
Volatile Organic Compounds (VOCs)[d]	N/A	N/A	Report	Twice per season	Grab
Other Dissolved and Total Recoverable Metals [c]	N/A	N/A	Report	Twice per season	Grab

Notes:

a. The "monthly geometric mean" is the geometric mean of all samples taken during the calendar month. A non-detect value may be substituted with a value of 1 for the purpose of calculating the geometric mean. If only one sample is collected, the result of that sample is the geometric mean.

b. The "monthly average" is the average of all samples taken during the calendar month. If only one sample is collected, the result of that sample is the monthly average.

c. A non-detect value may be substituted with a value of 0 for the purpose of calculating the monthly average.

d. The specific pollutants are listed in the most recent version of the Department approved QA/QC plan.

Table 2: Effluent Limits and Discharge Reporting for Hamworthy Wastewater Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in Table **1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b, c]	Minimum Frequency	Sample Type
Ammonia	28 mg/L	143mg/L	Twice per month	Grab
Copper	87 µg/L	133 µg/L	Twice per month	Grab
Nickel	63 µg/L	63 µg/L	Twice per month	Grab
Zinc	395 µg/L	395 µg/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Table 3: Effluent Limits and Discharge Reporting for Marisan Wastewater Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in Table **1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b, c]	Minimum Frequency	Sample Type
Ammonia	20 mg/L	20 mg/L	Twice per month	Grab
Copper	87µg/L	157 µg/L	Twice per month	Grab
Nickel	24 µg/L	24 µg/L	Twice per month	Grab
Zinc	112 µg/L	112 µg/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Table 4: Effluent Limits and Discharge Reporting for Rochem Wastewater Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in Table **1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b,c]	Minimum Frequency	Sample Type
Ammonia	12 mg/L	12 mg/L	Twice per month	Grab
Copper	10 µg/L	10 ug/L	Twice per month	Grab
Nickel	10 µg/L	10 ug/L	Twice per month	Grab
Zinc	118 µg/L	118 ug/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Table 5: Effluent Limits and Discharge Reporting for Scanship Wastewater Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in **Table 1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b, c]	Minimum Frequency	Sample Type
Ammonia	28 mg/L	68 mg/L	Twice per month	Grab
Copper	26 ug/L	26 ug/L	Twice per month	Grab
Nickel	28 ug/L	28 ug/L	Twice per month	Grab
Zinc	267 ug/L	267 ug/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Table 6: Effluent Limits and Discharge Reporting for Zenon Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in **Table 1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b, c]	Minimum Frequency	Sample Type
Ammonia	28 mg/L	51 mg/L	Twice per month	Grab
Copper	50 ug/L	50 ug/L	Twice per month	Grab
Nickel	40 ug/L	40 ug/L	Twice per month	Grab
Zinc	188 ug/L	188 ug/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Table 7: Effluent Limits and Discharge Reporting for All Other Wastewater Treatment Systems

(These effluent limits apply in addition to the effluent limits listed in **Table 1**.)

Parameter	Daily Maximum Continuous [a]	Daily Maximum Underway [b,c]	Minimum Frequency	Sample Type
Ammonia	28 mg/L	130 mg/L	Twice per month	Grab
Copper	87 ug/L	130 ug/L	Twice per month	Grab
Nickel	43 ug/L	43 ug/L	Twice per month	Grab
Zinc	360 ug/L	360 ug/L	Twice per month	Grab

Notes:

a. This effluent limit applies to wastewater discharged while docked, anchored, or moving at less than 6 knots.

b. This effluent limit applies to wastewater discharged while underway traveling at a speed of 6 knots or greater.

c. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Significant Changes from the 2008 Large Commercial Passenger Vessel Wastewater Discharge General Permit (2007DB0002)

- The fecal coliform monthly limit is now a geometric mean instead of an arithmetic mean;
- The effluent limit for chlorine now applies to all permitted vessels. Previously, the chlorine effluent limit only applied to permittees that used chlorine as a disinfectant in the wastewater treatment works process;
- Ammonia, copper, nickel, and zinc effluent limits are established based on the type of wastewater treatment system used;
- There are two effluent limits for some parameters- one applies to wastewater that is discharged while the vessel is travelling at a speed of 6 knots or greater (underway) and one applies to wastewater that is discharged continuously (while, docked, anchored, or moving at less than of 6 knots);
- The effluent limits for copper, nickel, and zinc have been adjusted based upon the ADEC analysis of the larger data set that includes 2008 and 2009 information; and
- The compliance schedule and associated requirements (Source Reduction Evaluations) were eliminated.

Table 8 compares the parameters for which the effluent limits have changed from the 2008 General Permit to the 2010 General Permit.

Table 8: Comparison of Ammonia, Copper, Nickel, and Zinc Effluent Limits between the 2008 General Permit and the 2010 General Permit

Parameter	Ammonia [a]	Copper [b]	Nickel [b]	Zinc [b]
Units	**mg/L**	**µg/L**	**µg/L**	**µg/L**
Alaska Water Quality Standards	1 [a]	3.1	8.2	81
2008 GP Long Term Limits	2.9 [c]	3.1	8.2	81
2008 GP Permit Interim Limits	80.4	66	180	230
2010 GP Continuous Discharge Limits				
Hamworthy	28	87	63	395
Marisan	20	87	24	112
Rochem	12	10	10	118
Scanship	28	26	28	267
Zenon	28	50	40	188
Other Treatment Systems	28	87	43	360
2010 GP Underway Limits[d]				
Hamworthy	143	133	63	395
Marisan	20	157	24	112
Rochem	12	10	10	118
Scanship	68	26	28	267
Zenon	51	50	40	188
Other Treatment Systems	130	130	43	360

Notes:

a. Based on the Alaska Water Quality Criteria Manual for Toxics (12/12/2008) using an average salinity

Table 8: Comparison of Ammonia, Copper, Nickel, and Zinc Effluent Limits between the 2008 General Permit and the 2010 General Permit

Parameter	Ammonia [a]	Copper [b]	Nickel [b]	Zinc [b]
Units	mg/L	µg/L	µg/L	µg/L

of 20 g/kg, a pH of 8.2 and a temperature of 10 -15˚ C.

b. Dissolved.

c. 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 7.8, salinity of 20 g/kg and temperature between 10-15 degrees Celsius.

d. For the 2010 season, this is a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit, the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season.

Background

History

The ADEC Commercial Passenger Vessel Environmental Compliance (CPVEC) Program was established in July 2001 by Alaska Statute (AS) 46.03.460 - AS 46.03.490. State law set effluent limits and sampling requirements for the discharge of blackwater (toilet water) and graywater (accommodations, galley, and laundry water) from large commercial passenger vessels ("cruise ships"). Cruise ships that discharged treated sewage in Alaska were required to take samples of discharged wastewater. Effluent limits were established at 200 fecal coliform per 100 mL and 150 mg/L of Total Suspended Solids (TSS).

In August 2006, Alaskan voters approved a ballot measure that added new requirements to the CPVEC Program. Among several other new provisions, the statute required owners/operators of large commercial passenger vessels to obtain a wastewater discharge permit from ADEC for the discharge of any treated sewage, treated graywater, or other treated wastewater into marine waters of the state. The new law required that cruise ship wastewater effluent meet Alaska Water Quality Standards (WQS) at the point of discharge.

The 2008 ADEC Large Commercial Passenger Vessel Wastewater Discharge General Permit No. 2007DB0002 was developed to satisfy this new law. That permit was issued on March 25, 2008. On April 9, 2008, the Alaska Cruise Association requested an informal review of the permit. The ADEC Director of the Division of Water issued a decision on April 24, 2008. Based on that decision several corrections were made to citations and schedules in the original permit. The revised permit was issued on May 1, 2008.

In addition to the 2001 state statutory requirements, the 2008 General Permit required additional reporting and sampling requirements, and contained new limits for several wastewater parameters. The permit established long term effluent limits for ammonia, copper, nickel, and zinc that applied Alaska Water Quality Standards (WQS) at the point of discharge beginning in 2010. The permit also contained less stringent interim (2008 and 2009) limits for these four parameters to allow ship owners and operators time to improve effluent quality. The interim limits required cruise ship operators to submit a Source Reduction Evaluation (SRE) to ADEC that documented progress and actions taken by the vessel operators to achieve the long-term limits.

Current Law and ADEC Finding Regarding Economically Feasible and Technologically Effective Treatment

House Bill (HB) 134 was passed by the Legislature in 2009. This bill allows ADEC to issue a three year General Permit to cruise ships that contains effluent limits or standards that are less stringent than the WQS at the point of discharge if the Department finds that a permittee is using economically feasible methods of pollution prevention, control, and treatment that the Department considers to be the most technologically effective in controlling all wastewater and other substances at the point of discharge but the permittee is unable to achieve compliance with WQS at the point of discharge.

Cruise ships that discharge wastewater into marine waters of the state had, at significant cost, installed Advanced Wastewater Treatment Systems (AWTS) before or during 2003. The General Permit requires use of AWTS as a condition of discharge. Because there are different manufacturers of AWTS and they produce varying levels of effluent quality, the General Permit includes effluent limits specific to the type of treatment system, ensuring that those systems that can do better than others are required to do so.

The U.S. Environmental Protection Agency (EPA) published a December 29, 2008 analysis, the "Cruise Ship Discharge Assessment Report", which evaluated the state of cruise ship wastewater treatment technologies, their effectiveness, and other existing technologies that could potentially be employed on cruise ships. EPA stated the following in the report:

"2.4.4 Potential Treatment Technologies in Addition to AWTs

> As part of its assessment of the large cruise ship sewage and graywater discharge standards in Alaska, EPA is evaluating upgrades to AWTs and technologies that could be added on to AWTs that would improve the quality of the treated effluent in terms of nutrients, metals, and temperature. These technologies have not been used or tested on cruise ships for the treatment of sewage or graywater. However, EPA believes these technologies are potentially feasible for this application because they currently are used in other shipboard applications or because they currently are used in land-based wastewater treatment facilities and could be adapted for shipboard application. Use of these technologies onboard large cruise ships would require engineering studies to adapt existing designs and materials selection (e.g., metallurgy, membrane and resin selection, loading rates, reliability, space constraints), operating parameters (e.g., pressures, temperatures, service and maintenance cycles), and training for operating personnel to ensure effective and consistent performance and minimize operating costs."

ADEC conducted its own review of cruise ship wastewater technologies, conducting a technology conference on February 18, 2009 and a follow-up report. DEC's primary conclusion from this effort was that AWTS are very effective wastewater treatment systems. While other new and emerging technologies, as well as some existing technologies used in shore-based facilities could result in improvements to cruise ship effluent quality, none are currently readily available (and therefore economically feasible) for installation and use on the entire cruise ship fleet that discharges in marine waters of the state. ADEC finds that cruise ships are currently using the most technologically effective treatment systems that are economically feasible.

Per HB 134, ADEC has established a Science Advisory Panel to evaluate changes over time to what types of wastewater treatment might become economically feasible and more technologically effective in terms of producing higher quality wastewater effluent. Improvements will be reflected in amendments to the existing General Permit or in future renewals of the General Permit.

Operation under the General Permit

Discharges Allowed:

The 2010 Cruise Ship General Permit only authorizes discharge of waste streams specifically mentioned in the permit. All discharges authorized under the 2010 General Permit shall be consistent with the terms and conditions of the permit and approved plans (e.g. Vessel Specific Sampling Plans, Quality Assurance/Quality Control Plan).

Vessels that do not discharge wastewater into marine waters of the state are not required to apply for coverage under the General Permit.

Definition of Marine Waters of the State (areas covered by the permit):

- All waters within the boundaries of the state (3 nautical miles from the baseline from which territorial seas are measured);
- Waters of the Alexander Archipelago as defined in AS 46.03.490 (18).

Marine waters of the state include areas that are outside of the definition of the Alexander Archipelago, but within 3 nautical miles from shore. These areas include, but are not limited to: Hazy Islands, Forrester Island, Wolf Rock, and Lowrie Island.

Discharge Exclusion Areas:

The scope of the permit does not include the waters of Glacier Bay National Park and Preserve. Discharges are prohibited within the Park by the U. S. National Park Service's concession contract with large cruise ships for entry into the Park.

For purposes of this permit, waters of Glacier Bay National Park and Preserve means all waters inside a line drawn between Point Gustavus at 135°54.927' W longitude; 58°22.748' N latitude and Point Carolus at 136°2.535' W longitude; 58°22.694' N latitude.

The 2010 General Permit prohibits wastewater discharges in certain areas including any waterbody included in the ADEC Clean Water Act (CWA) Section 305(b) report or effective CWA Section 303(d) list of waters which are "impaired" or "water quality-limited" for any of the pollutant parameters, for which there are effluent limits. At the time of the issuance of the 2010 General Permit, these areas include Skagway Harbor and Klag Bay. Klag Bay is located on the west side of Chicagof Island. Skagway Harbor is defined as being northeast of the line from Yakutania Point at 135° 20' 13"N, 59° 27' 7"N, approximately southeast, to a point at 135° 19' 43"W, 59° 26' 32"N.

For more information on the ADEC list of impaired waterbodies visit:

http://www.dec.state.ak.us/water/wqsar/waterbody/integratedreport.htm

Discharge Characterization

The wastewater treatment systems that are used on large cruise ships that discharge into marine waters of the state have generally performed well at treating the conventional effluent parameters that have been monitored (sampled regularly) by ADEC and the U.S. Coast Guard since 2001. Conventional parameters includes fecal coliform bacteria counts (an indicator of potential pathogens), pH, chlorine, biological oxygen demand, and total suspended solids. An exceedance of one of these parameters may be an indicator of improperly working equipment.

Cruise ships that discharge wastewater into marine waters of the state had installed Advanced Wastewater Treatment Systems (AWTS) before or during 2003. By the end of the 2004 cruise ship season, sample results indicated substantial improvements in effluent quality for fecal coliform, biochemical oxygen demand, and chlorine. Wastewater sample results can be found on the ADEC Cruise Program website at: http://www.dec.state.ak.us/water/cruise_ships/reports.htm.

The 2008 General Permit required additional wastewater sampling and contained new limits for several parameters. Long term effluent limits for ammonia, copper, nickel, and zinc were equivalent to Alaska WQS. Less stringent limits (interim limits) were allowed for these parameters during the 2008 and 2009 Alaska cruise ship seasons. Table 9 and Table 10 below summarize wastewater sample results for 2008 and 2009.

Table 9: Summary of 2008 Large Ship Sampling Results (21 ships, 206 samples)

Parameter	Ammonia as N	Copper [a]	Nickel [a]	Zinc [a]	pH	Bio-chemical O_2 Demand	Total Suspended Solids	Total Residual Chlorine	Fecal Coliform Daily Max
Units	**mg/l**	**µg/L**	**µg/L**	**µg/L**	**S.U.**	**mg/L**	**mg/L**	**mg/L**	**MPN/ 100 mL**
Alaska WQS	2.9 [b]	3.1	8.2	81	6.5 – 8.5	N/A	N/A	0.0075	43
Minimum	0	0	0	0	6.18	0	0	0	0
Maximum	150	140	43.2	501	9.2	126	99	0.10	210
Median	25	7.23	9.1	73.5	7.28	3	0	0	0

Notes:

a. Dissolved metals.

b. Ammonia standard was 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 7.8, salinity of 20 g/kg and temperature between 10-15 degrees Celsius. The ammonia WQS for the 2010 Permit is 1 mg/L based on the latest and most comprehensive Southeast Alaska ambient water data, with a pH of 8.2, a salinity of 20 g/kg, and a temperature of 10-15 degrees C.

Table 10: Summary of 2009 Large Ship Sampling Results (19 ships, 201 samples [a])

Parameter	Ammonia as N	Copper [b]	Nickel [b]	Zinc [b]	pH	Bio-chemical O_2 Demand	Total Suspended Solids	Total Residual Chlorine	Fecal Coliform Daily Max
Units	**mg/l**	**µg/L**	**µg/L**	**µg/L**	**S.U.**	**mg/L**	**mg/L**	**mg/L**	**MPN/100 mL**
Alaska WQS	2.9 [c]	3.1	8.2	81	6.5 – 8.5	N/A	N/A	0.0075	43
Minimum	0	0	0	0	6.28	0	0	0	0
Maximum	160	130	420	450	8.32	45	116	0.11	4,800
Median	37.5	9.35	9.9	84.5	7.37	3.6	0	0	0

Notes:

a. Does not include resample events.

b. Dissolved metals.

c. Ammonia standard was 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 7.8, salinity of 20 g/kg and temperature between 10-15 degrees Celsius. The ammonia WQS for the 2010 Permit is 1 mg/L based on the latest and most comprehensive Southeast Alaska ambient water data, with a pH of 8.2, a salinity of 20 g/kg, and a temperature of 10-15 degrees C.

Large cruise ships that discharged wastewater into marine waters of the state in 2008 and 2009 had the most difficulty meeting the long-term effluent limits for ammonia and copper. For more information about the 2008 sample results, see the ADEC "Large Cruise Ship 2008 Wastewater

Sampling Results" found at:
http://www.dec.state.ak.us/water/cruise_ships/pdfs/2008_LargeShip_WW_Sampling.pdf

Large Cruise Ship Sample Spreadsheet" found at:
http://www.dec.state.ak.us/water/cruise_ships/SciencePanel/documents/Binder/Permit_Sample_Data_CPVEC_2009.pdf

Large cruise ships that discharge wastewater into marine waters of the state use several different types of advanced wastewater treatment systems (AWTS). A comparison of the sample results achieved by different treatment technologies can be found in Table 11.

Table 11: Comparison of Advanced Wastewater Treatment System Medians [a] (2004-2008)

	Ammonia	Copper	Nickel	Zinc
Wastewater Treatment Systems	**mg/L**	**µg/L**	**µg/L**	**µg/L**
Rochem	0.9	1	0.87	11.2
Zenon	13.5	6	12.4	61.4
Scanship	28	4.31	9.7	70.5
Hamworthy	48.5	13	8.5	110
Marisan	0.3	52	13.9	21

Note:
a. Does not include Hamman and Hydroxyl, in both systems there were too few samples for a meaningful comparison.

The volume of treated wastewater discharge varies from vessel to vessel. It ranges from a maximum of 91,711 gallons per day (approximately 366 cubic meters/day) to a maximum of 330,000 gallons per day (approximately 1,250 cubic meters per day). For purposes of comparison, Table 12 below contrasts two different cruise ship populations and discharge volumes with the population and discharge volume from two small municipal wastewater treatment systems in southeast Alaska. Cruise ships produce fewer gallons per day per person of wastewater compared to a comparably sized municipality due to water conservation measures that are employed on board.

Table 12: Comparison of Cruise Ship Discharge Volume[a] with that of Similarly Populated Southeast Alaska Municipalities[b]

	Cruise Ship 1	Cruise Ship 2	Petersburg	Craig
Total population	4,230	2,728	3,009	1,117
Wastewater production	330,000 gals/day (maximum load)	187,165 gals/day (maximum load)	475,000 gals/day (average April 2008)	186,000 gals/day (average March 2008)

Notes:
a. (Source of cruise ship data: 2009 Discharge Monitoring Reports)
b. (Source of municipal data: 2008 Discharge Monitoring Reports)

Dilution Studies:

Dilution while Stationary:

In July 2008, ADEC and EPA conducted a joint field study to characterize the near-field (0 – 15 meters) dilution that occurs to wastewater that is discharged from a stationary cruise ship. The field study was conducted in Skagway Harbor, considered to be a conservative "worst case"

location for dilution. The lowest dilution factor (i.e. worst case; least dilution) that was calculated at a distance of 15 meters from the discharge port was during the study was 1/28.

ADEC used the dilution factor of 1/28 to determine the water quality based effluent limits for wastewater that is discharged when a vessel is docked, anchored or moving at less than 6 knots.

See the ADEC report entitled "Assessment of Stationary Cruise Ship Plume Dilution" for more information. This study is available at:
http://www.dec.state.ak.us/water/cruise_ships/pdfs/2009_Plume_Dilution_Study.pdf

Dilution while Underway:

A 2002 Science Advisory Panel and ADEC report concluded that for a typical large cruise ship moving at a minimum speed of 6 knots and discharging wastewater at 200m^3/hr the dilution factor on the wastewater effluent is 50,000 (See "The Impact of Cruise Ship Wastewater Discharge on Alaska Waters," November 2002, available at:
http://www.dec.state.ak.us/water/cruise_ships/pdfs/impactofcruiseship.pdf).

ADEC used the dilution factor of 1/50,000 to determine the water quality based effluent limits for wastewater that is discharged when a vessel is underway.

For the 2010 season only, while the vessel is underway, the permit includes ammonia, copper, nickel, and zinc parameters with a monitoring and reporting requirement only. For any samples collected in 2010 that exceed the limit in the treatment system-specific tables of the permit (Tables 2-7), the permittee must, with the DMR, provide a written explanation of the known or likely cause(s) of the exceedance and the corrective measures the permittee will take to address the cause(s) before the 2011 season. During 2010 any exceedance of the ammonia, copper, nickel, or zinc limit while underway would still be subjected to the 1/50,000 dilution factor and the water quality standards will still be met in the receiving water.

For example, an exceedance equivalent to the highest measurement from the 2004-2009 data set for each parameter would yield the following: ammonia at 160 mg/L with a dilution factor of 1:50,000 would be 0.0032 mg/L, well below the water quality standard of 1 mg/L; copper at 172 µg/L with a dilution factor of 1:50,000 would be 0.00344 µg/L, well below the water quality standard of 3.1 µg/L; nickel at 420 µg/L with a dilution factor of 1:50,000 would be 0.0084 µg/L, well below the water quality standard of 8.2 µg/L; and zinc at 501 µg/L with a dilution factor of 1:50,000 would be 0.01002 µg/L, well below the water quality standard of 81 µg/L. In summary, even if vessels discharge these substances at the highest concentrations seen to date, concentrations in receiving waters would still be less than one percent of the water quality standards.

Table 13: Applying Dilution Factor While Underway to Maximum Detected Values
(2004 – 2009 data set for all vessels)

	Ammonia	Copper	Nickel	Zinc
Maximum value detected	160 mg/L	172 µg/L	420 µg/L	501 µg/L
Underway Dilution Factor	50,000	50,000	50,000	50,000
Expected Concentration in Receiving Water	0.0032 mg/L	0.00344 µg/L	0.0084 µg/L	0.01002 µg/L
WQS	1 mg/L	3.1 µg/L	8.2 µg/L	81 µg/L

Effluent Limitations

Alaska's Water Quality Standards (18 AAC 70) include three articles: Article 1, statewide standards (18 AAC 70.005 -.050), Article 2, exceptions to state-wide standards (18 AAC 70.200 -.270), and Article 3, general provisions (18 AAC 70.900 -.990). The standards also include the Alaska Water Quality Criteria Manual for Toxic and Deleterious Organic and Inorganic Substances. The Alaska Water Quality Criteria Manual for Toxic and Deleterious Organic and Inorganic Substances has been adopted into 18 AAC 70.020(b). Numeric criterion for certain pollutants in the 2010 General Permit (i.e., fecal coliform) are found in 18 AAC 70.020 (b).

The Alaska Water Quality Standards are found at:
http://www.dec.state.ak.us/water/wqsar/wqs/wqs.htm

A presentation on the Water Quality Standards and the parameters of concern (ammonia, copper, nickel, and zinc can be found at:

http://www.dec.state.ak.us/water/cruise_ships/SciencePanel/documents/Alaska_WQS_Cruise_Ship_mtg_powell

When ADEC issues permits for shore-based domestic wastewater treatment plants, it may authorize a mixing zone where water quality standards can be exceeded, while still protecting receiving waters. However, the 2006 law that pertained to cruise ships required that all discharges meet applicable standards -- including Alaska Water Quality Standards -- ***at "the point of discharge***," (AS 46.03.462(b)(1)(emphasis added)). ADEC concluded that the 2006 law precluded authorization of a dilution factor or mixing zone in the final 2008 General Permit for parameters that had exceeded the WQS in the effluent in recent years - ammonia, copper, nickel, and zinc.

ADEC issued the 2008 General Permit with long term effluent limits that were equivalent to the WQS. Public comment and ADEC analysis indicated that the cruise ships were not likely to be able to immediately comply with the strict long term effluent limits for ammonia, copper, nickel, and zinc. Therefore, the 2008 General Permit included interim effluent limits for the 2008 and 2009 cruise ship seasons. The upper 95th percentile limit of the 2004 through 2007 data was selected as the interim effluent limit for these parameters. The 95th percentile would mean that 5% of the samples would exceed the established effluent limits. It was selected to encourage improvements in effluent through development and implementation of Source Reduction Evaluations.

In 2009, House Bill (HB) 134 was passed by the Alaska Legislature. This new law addressed the challenges cruise ships had in meeting the long term limits at the point of discharge. Without HB 134, WQS would apply to large cruise ship wastewater at the point of discharge beginning in 2010. The law now allows ADEC to issue a permit that:

"may include effluent limits or standards less stringent than those required under (b)(1) of this section for not more than three years duration if the department finds that a permittee is using economically feasible methods of pollution prevention, control, and treatment the department considers to be the most technologically effective in controlling all wastes and other substances in the discharge but is unable to achieve compliance with Alaska Water Quality Standards at the point of discharge." (AS 46.03.462(e))

In determining the effluent limits that were included in the 2010 General Permit for cruise ships, ADEC followed a similar methodology that is used when EPA issues municipal wastewater permits. A technology based limit and a water quality based effluent limit were both determined for ammonia, copper, nickel, and zinc for effluent discharged while the vessel was docked, anchored, or moving at less than 6 knots and for effluent discharged while the vessel was underway (6 knots or greater). Then the stricter of the technology or water quality based effluent limit was selected as the effluent limit for ammonia, copper, nickel, and zinc in the 2010 General Permit.

The technology based effluent limit for the final permit was calculated as the upper 99^{th} percentile limit of the 2004 to 2009 wastewater sample data set for the specific wastewater treatment systems used on the ships. The technology based effluent limit for Table 7 (Other Wastewater Treatment Systems) in the final permit is based upon the pooled data set - all ships during the 2004 to 2009 time period.

The 99^{th} percentile was selected, in part, because of the more robust data set now available (increased understanding of the data consistency and variability) and because ADEC has set effluent limits in the new permit based upon the capabilities of specific treatment systems to ensure effluent limits reflect the capabilities of each specific wastewater treatment technology while also being protective of water quality. Use of the 99^{th} percentile presumes that if the ships and treatment systems continue to operate as they have in the past, 1% of the samples will exceed the effluent limits. Use of the 99^{th} percentile is an option under EPA's federal wastewater discharge permitting guidance and is protective of receiving water quality and waterbody uses.

ADEC then selected the more conservative (lower limit) of either the technology based effluent limit (99^{th} percentile) or the water quality based effluent limit for each type of wastewater treatment technology. The more conservative limit for ammonia, copper, nickel, and zinc became the effluent limit in the General Permit Tables 2 through 7.

Table 14: Comparison of 99th Percentile Technology Based Effluent Limit versus Water Quality Based Effluent Limit While Stationary

Note: When the technology based effluent limit is lower than the water quality based effluent limit, the number became the effluent limit in the permit and is **bolded** and shaded. Otherwise the water quality based effluent limit became the effluent limit in the permit.

Wastewater Treatment System		Ammonia (mg/L)	Copper (µg/L)	Nickel (µg/L)	Zinc (µg/L)
	WQS	1	3.1	8.2	81
	2008 Interim limits	80.4	66	180	230
	WQ based effluent limit	28	87	230	2,300
Hamworthy		143	133	**63**	**395**
Marisan		**20**	157	**24**	**112**
Rochem		**12**	**10**	**10**	**118**
Scanship		68	**26**	**28**	**267**
Zenon		51	**50**	**40**	**188**
Other Wastewater Treatment System		130	130	**43**	**360**

The water quality based effluent limit for each parameter was determined by multiplying the WQS and the dilution factor. The dilution factor applied to determine the water quality based effluent for wastewater that is discharged while the vessel is docked, anchored or while travelling at less than 6 knots was 1/28 based upon the joint ADEC and EPA study of stationary dilution. This dilution factor means that all WQS will be met in the receiving water within 15 meters of the discharge port. The dilution factor applied to determine the water quality based effluent for wastewater that is discharged while the vessel is underway (traveling at 6 knots or greater) was 1/50,000, based upon the previous findings of a Science Panel. In applying these dilution factors in the permit, ADEC considered and finds that the provisions of 18 AAC 70.240 (mixing zones) have been met.

BOD (Biochemical Oxygen Demand)

There is no change from the effluent limits in the 2008 General Permit.

Alaska Water Quality Standards do not contain a numeric criterion for BOD. BOD is a technology based standard that is a useful indicator of the effectiveness of wastewater treatment. The 2010 General Permit uses the limit established in 40 CFR 133.102 Secondary Standard which apply to cruise ships in Alaska per U.S. Coast Guard requirements. This limit is a daily maximum of 60 mg/L and a monthly average limit of 30 mg/L.

Fecal Coliform

The 2008 General Permit used the most stringent state WQS for the raw consumption of aquatic life of 14 FC/100 ml for a monthly arithmetic average and 43 FC/100 ml for a daily maximum.

In the 2010 General Permit, the effluent limits remain the same. However, the statistical method to calculate the monthly limit has been changed from an arithmetic mean to a geometric mean. A geometric mean is the standard statistic applied to fecal coliform. A geometric mean is applied as the metric for the federal cruise ship effluent limit (33 CFR 159.309). Geometric

means are also frequently applied to fecal coliform effluent limits in municipal permits in Alaska.

Total Residual Chlorine

The effluent limit in the 2008 General Permit for total residual chlorine was 0.0075 mg/L (7.5µg/L). However, the permit only required monitoring for chlorine if vessels used chlorine as part of their treatment process. Wastewater samples obtained to satisfy the requirements of the Quality Assurance \ Quality Control Plan occasionally indicated detectable levels of chlorine above Alaska WQS. Potential sources of chlorine include, but are not limited to: pool water, spa water, cleaning of the treatment system or distribution piping prior to a sample, and the chlorine that is present in potable (drinking) water.

Chlorine had been used in the past to disinfect (remove bacteria and viruses) treated wastewater prior to discharge. It can also be an alternative method of disinfection in case of failure of a primary disinfection system or to clean discharge piping to remove fecal coliform aftergrowth. Most current AWTS use ultraviolet light rather than chlorine to disinfect wastewater. Chlorine has been known to damage the membranes of some AWTS, which would lead to a reduction of efficiency or ability to properly treat wastewater.

Free residual chlorine is described as the portion of the chlorine injected into water that remains as molecular chlorine, hypochlorous acid, or hypochlorite ions after the solution has reached a state of equilibrium. Total residual chlorine includes free chlorine, but also includes chlorine that has combined with ammonia or other nitrogenous compounds. ADEC marine water quality criteria for total residual chlorine are 13 ug/L (acute criterion) and 7.5 ug/L (chronic criterion). The acute criterion is based upon a 24-hour average concentration. The chronic criterion is based upon a four-day average concentration.

In setting the effluent limit, ADEC considered using the chronic criterion multiplied by the dilution factor of 28 for an effluent limit of 210 ug/L (28 * 7.5 ug/L). However, ADEC determined that, per the state antidegradation policy that requires treatment to the "highest statutory and regulatory requirements," the effluent limit established by the U.S. Coast Guard of 10 ug/L for continuous discharge in 33 CFR Part 159 Subpart E is more stringent. The 2010 General Permit therefore establishes a chlorine limit of 10 µg/L for all cruise ships that discharge wastewater into marine waters of the state. The limit, however, is below the detection level for most EPA-approved analytical methods. Therefore, effluent samples will be considered compliant with the total residual chlorine limit if the sampled chlorine concentration is below the method detection limit of the analytical method used.

pH

There is no change from the effluent limits in the 2008 General Permit.

Federal rules (40 CFR 133.102 Secondary Treatment) establish the criterion for pH at a value between 6 and 9. The most stringent state water quality criterion for pH (for aquaculture water supply and aquatic life) states that pH must be no less than 6.5 and no greater than 8.5 standard units and may not vary more than 0.2 pH units from natural conditions. The final General Permit limits pH to a range of 6.5 to 8.5 standard units.

Total Suspended Solids (TSS)

There is no change from the effluent limits in the 2008 General Permit.

The Alaska Water Quality Standards do not contain a numeric criterion for TSS. It is a technology based standard. The General Permit is based upon the limit (150 mg/L) established in Alaska's statutes relating to cruise ships, AS 46.03.463(b).

Ammonia

Toxicity of Ammonia

Ammonia affects the life cycle as well as survival of some species. Ammonia at concentrations less than those chronically toxic to animals may stimulate growth and reduce reproduction of some red macroalgal species. Ammonia is primarily a product of biological processes such as microbial digestion of sewage due to the presence of urine. Ammonia is also present in some cleaning products.

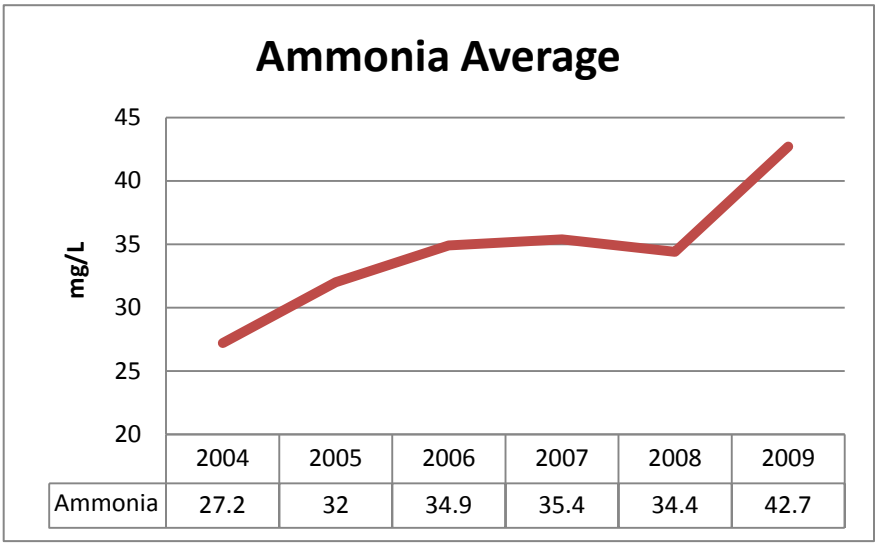
Toxicity and Speciation

Ammonia is present in two forms in saltwater: un-ionized ammonia (NH_3) and the ammonium ion (NH_4+). The pH, temperature, and salinity of the receiving water govern the speciation of ammonia and, therefore, its toxicity. Un-ionized ammonia is the more toxic form, but because ionic ammonium is often present in much greater concentrations, its toxicity must be considered. Both total ammonia ($NH_3 + NH_4^+$) and un-ionized ammonia (NH_3) are included in the water quality standards because both can have toxic effects on aquatic life under certain conditions.

Technology Based Effluent Limits

The ADEC calculation of a technology based ammonia effluent limit for the 2010 General Permit was based on the 2004 – 2009 cruise ship wastewater data set. Cruise ships that were granted interim ammonia effluent limits in 2008 and 2009 were required to sample for ammonia twice per month. Therefore, the inclusion of the 2008 and 2009 wastewater sample data greatly increased the number of samples that were included in the calculation of the 99^{th} percent confidence interval.

Figure 1: Ammonia Averages in Wastewater Sample Results (2004-2009)



Water Quality Based Effluent Limits

ADEC derived an ammonia water quality standard of 1 mg/L using a receiving water pH of 8.2, a salinity of 20 g/kg, and a temperature of 10- 15 degrees Celsius. The determination of the ammonia water quality standard is heavily dependent upon the pH of the receiving water. The receiving water characteristics were selected using the 2004 Environmental Monitoring and Assessment Program (EMAP) data for Southeast Alaska. The EMAP data is presented in Table 15:

Table 15: Alaska Port Receiving Water Characteristics

Name	Vessel Visits in 2009	pH	Temperature (C)	Salinity (PSU)
Juneau	514	8.35	14.2	13.1
Ketchikan [a]	479	8.27 [a]	17.3	24.86
Skagway	383	8.02	11.8	9.5
Sitka	159	8.06	18.3	29.4
Point Sophia	69	8.25	15.1	25.5
Haines	33	8.24	12	10.7
	Average	8.20	14.78	18.84
	Median	8.25	14.65	18.98

Notes:

a. All results taken at or near the surface.

b. There was no pH data for Ketchikan harbor in EMAP. The pH from the closest site with similar geographic area, temperature, and salinity (Sumner Strait AK04-0014) was selected.

<u>Ammonia Effluent Limit while docked, anchored, or travelling at less than 6 knots (continuous discharge)</u>

ADEC multiplied the ammonia water quality standard of 1 mg/L and a dilution factor of 1/28 to calculate a water quality based effluent limit. Following this procedure, ADEC calculated an

ammonia effluent limit of 28 mg/L for a cruise ships that discharges continuously, including while docked, anchored or moving at less than 6 knots.

ADEC also calculated a technology based effluent limit based on specific wastewater treatment systems, using the 99th percentile of the 2004-2009 data.

ADEC selected the more conservative of the water quality based and technology based effluent limit for each type of treatment system. For Marisan and Rochem, the technology based effluent limits were more conservative and set at 20 mg/L and 12 mg/L, respectively. For Hamworthy, Scanship, Zenon, and other treatment systems, the water quality based effluent limit (28 mg/L), was more conservative (lower number).

Ammonia Effluent Limit while Underway

ADEC applied the ammonia water quality standard of 1 mg/L and a dilution factor of 1/50,000 to calculate a water quality based effluent limit of 50,000 mg/L for a cruise ship that is underway.

ADEC also calculated a technology based effluent limit based on specific treatment systems using the 99th percentile of the 2004-2009 data. In all cases, the technology based effluent limit was more conservative than the water quality based effluent limit and was used for the ammonia effluent limits in the General Permit for vessels while underway. See Table 8 above.

Copper

Toxicity of Copper

Alaska has a water quality standard of 3.1 ug/L dissolved copper in saltwater based on chronic effects to aquatic life and 4.8 ug/L for acute effects (Table IV in the Alaska Water Quality Criteria Manual for Toxics and Other Deleterious Organic and Inorganic Substances). The chronic criterion is based upon a four-day average. The acute criterion is based upon a 24-hour average. Copper can be toxic in aquatic environments and bio-concentrates in many different organs in fish and mollusks.

Potential Sources of Copper in Wastewater

Potential sources of copper/ copper alloys include but are not limited to: on board piping systems (copper pipes which can leach copper when exposed to soft potable water or electrical galvanic corrosion activity), cookware (although galley wastewater is not normally mixed with other wastewater), copper parts from evaporators which are used in making potable water onboard, copper used in refrigeration and air conditioning systems, and some disinfectants.

Copper Effluent Limits while docked, anchored, or travelling at less than 6 knots (continuous discharge)

ADEC multiplied the copper water quality standard of 3.1 µg/L and a dilution factor of 1/28 to calculate a water quality based effluent limit using a reasonable potential analysis for vessels while docked, anchored, or travelling at less than 6 knots. Following this procedure, ADEC calculated a water quality based copper effluent limit of 87 µg/L.

The ADEC calculation of a technology based copper effluent limit for the 2010 General Permit was based upon an evaluation of the 2004 – 2009 cruise ship wastewater data set. Cruise ships that were granted interim copper effluent limits in 2008 and 2009 were required to sample for copper twice per month. Therefore, the inclusion of the 2008 and 2009 wastewater sample data greatly increased the number of samples that were included in the calculation of the 99th percentile confidence interval for each type of treatment system which was used as the technology based effluent limit. ADEC also incorporated additional samples (obtained by ADEC) that were not included in the data set used to establish the technology based effluent limit (interim limit) in the 2008 General Permit.

For vessels that discharge continuously, the technology based effluent limit calculated by type of treatment system ranges from 10 ug/L to levels higher than the water quality based effluent limit (87 ug/L).

For the 2010 General Permit, ADEC selected the more conservative of the water quality based or technology based limits. For Rochem, Scanship, and Zenon the technology based effluent limits were more conservative and set at 10 ug/L, 26, ug/L, and 50 ug/L, respectively. For Hamworthy, Marisan, and other treatment systems, the water quality based effluent limit (87 ug/L), was more conservative.

Copper Effluent Limit while Underway

ADEC applied the copper water quality standard of 3.1 µg/L and a dilution factor of 1/50,000 to calculate a water quality based effluent limit using a reasonable potential analysis for vessels while underway. Following this procedure, ADEC calculated a copper effluent limit of 155,000 µg/L.

ADEC also calculated a technology based effluent limit for each type of treatment system based on the 99th percentile of the 2004-2009 data. In all cases, the technology based effluent limit was the more conservative value when a cruise ship is underway, and ADEC included the technology based limits for copper in the 2010 General Permit. See Table 8 above.

Nickel

Toxicity of Nickel

Alaska has a water quality standard of 8.2 µg/L dissolved nickel in saltwater based on chronic effects to aquatic life and 74 ug/L for acute effects (Table IV in the Alaska Water Quality Criteria Manual for Toxics and Other Deleterious Organic and Inorganic Substances). The chronic criterion is based upon a four-day average. The acute criterion is based upon a one-hour average.

Potential Sources of Nickel in Wastewater

Nickel is used as an alloy in pipes (such as stainless steel), valves, fittings, and plumbing fixtures. It could also be present in potable water sources.

Nickel Effluent Limits

The ADEC calculation of a technology based nickel effluent limit for the 2010 General Permit was based upon an evaluation of the 2004 – 2009 cruise ship wastewater data set. Cruise ships that were granted interim nickel effluent limits in 2008 and 2009 were required to sample for nickel twice per month. Therefore, the inclusion of the 2008 and 2009 wastewater sample data greatly increased the number of samples that were included in the calculation of the 99th percent confidence interval. ADEC also incorporated additional samples (taken by ADEC) that were not included in the data review used to establish the effluent limits in the 2008 General Permit. The interim effluent limit for nickel in the 2008 General Permit was 180 µg/L (0.18 mg/L).

Nickel Effluent Limits while underway and while docked, anchored, or travelling at less than 6 knots (continuous discharge)

ADEC multiplied the nickel water quality standard of 8.2 µg/L and a dilution factor of 1/28 to calculate a water quality based effluent limit using a reasonable potential analysis for a vessel while docked, anchored, or travelling at less than 6 knots. Following this procedure, ADEC calculated a nickel effluent limit of 230 µg/L.

ADEC also applied the nickel water quality standard of 8.2 µg/L and a dilution factor of 1/50,000 to calculate a water quality based effluent limit using a reasonable potential analysis for a vessel that is underway. Following this procedure, ADEC calculated a water quality based effluent limit for nickel of 410,000 µg/L.

ADEC then calculated technology based effluent limits for Nickel for the different types of treatment systems. Those limits range from 10 ug/L to 63 ug/L based on the type of treatment system.

In all cases, the technology based effluent limit was more conservative than the water quality based effluent limit and was used for the nickel effluent limits in the General Permit for vessels while underway as well as while docked, anchored or travelling at less than 6 knots. See Table 8 above.

Zinc

Toxicity of Zinc

Alaska has a water quality standard of 81 ug/L dissolved zinc in saltwater based on chronic effects to aquatic life and 90 ug/L for acute effects (Table IV in the Alaska Water Quality Criteria Manual for Toxics and Other Deleterious Organic and Inorganic Substances). The chronic criterion is based upon a four-day average. The acute criterion is based upon a one-hour average. Toxicity of zinc to an organism depends on feeding habits. Plants and most fish would not be adversely affected, but invertebrates could be affected by ingestion of sufficient quantity of particulates containing zinc.

Potential Sources of Zinc in Wastewater

Zinc can be found in some types of piping, fittings, and valves. It is used as a coating to protect against corrosion. Zinc is also used as a sacrificial anode in cathodic protection. Zinc has been used in antifouling paints in tanks. Other potential sources of zinc include: sunscreen and diaper rash cream, toothpaste, vitamin supplements, potable water sources, and shampoos.

Zinc Effluent Limits while underway and while docked, anchored, or travelling at less than 6 knots (continuous discharge)

The ADEC calculation of a technology based zinc effluent limit for the 2010 General Permit was based upon an evaluation of the 2004 – 2009 cruise ship wastewater data set. Cruise ships that were granted interim zinc effluent limits in 2008 and 2009 were required to sample for copper twice per month. Therefore, the inclusion of the 2008 and 2009 wastewater sample data greatly increased the number of samples that were included in the calculation of the 99th percent confidence interval. ADEC also incorporated additional samples (taken by ADEC) that were not included in the data review for the 2008 General Permit. The interim effluent limit for zinc in the 2008 General Permit was 230 µg/L (0.23 mg/L).

ADEC applied the zinc water quality standard of 81 µg/L and a dilution factor of 1/28 to calculate a water quality based effluent limit using a reasonable potential analysis for a vessel while docked, anchored or travelling at less than 6 knots. Following this procedure, ADEC calculated a zinc effluent limit of 2,268 µg/L.

ADEC also applied the zinc water quality standard of 81 µg/L and a dilution factor of 1/50,000 to calculate a water quality based effluent limit using a reasonable potential analysis for a vessel that is underway. Following this procedure, ADEC calculated a zinc effluent limit of 4,050,000 µg/L.

ADEC then calculated technology based effluent limits for Zinc for the different types of treatment systems. Those limits range from 112 ug/L to 395 ug/L depending upon the type of wastewater treatment system.

In all cases, the technology based effluent limit was more conservative than the water quality based effluent limit and was used for the zinc effluent limits in the General Permit for vessels while underway and while docked, anchored or travelling at less than 6 knots. See Table 8 above.

Evaluation of other parameters for Potential Inclusion in Permit

ADEC also evaluated the wastewater sample results for several other metals that had occasionally exceeded the Alaska Water Quality Standards (WQS) including mercury, selenium, and silver. Sampling for these parameters was only required twice per season under the QA/QC Plan. Silver and mercury each had one exceedance in the past five years, while selenium had four. These parameters were not included in the 2010 General Permit because each parameter had few excedances and the upper 99th percentile of sample results was below WQS. ADEC will continue to monitor these and other pollutants for inclusion into future revisions of this General Permit.

Data Reliability and Representative Nature of Wastewater Samples

It is crucial that wastewater sample data is reliable and representative. This data will be used to determine compliance with the General Permit. Large vessels that discharged in Alaska from 2001 to 2007 took at least two compliance samples per cruise ship season to satisfy both state and federal cruise ship requirements.

In 2008 and 2009, large cruise ships that discharged wastewater into marine waters of the state were required to sample twice a month to satisfy the 2008 General Permit requirements. The same frequency of sampling is required in the 2010 General Permit.

ADEC, the U.S. Coast Guard, and the Northwest Cruiseship Association have established a Quality Assurance/Quality Control (QAQC) plan that ensures that the sample results are reliable and are representative of the wastewater that is discharged into marine waters of the state. The 2010 General Permit requires permittees to follow the most recent version of an ADEC-approved QAQC sampling plan.

The QAQC plan includes standard sampling and laboratory quality control elements with additional instructions tailored to a maritime facility. It lists all the pollutants to be tested and the EPA analytical methods to be used. The QAQC plan requirements include duplicate sampling, independent sampling audits, and a lab technical systems audit. The samples are obtained by a third party sampler and analyzed at an approved laboratory.

The 2010 General Permit and state statutes also allow ADEC or its representative to take additional wastewater samples and conduct additional analysis.

Because each ship is configured differently and follows unique wastewater management practices, the state also requires the owner/operator to submit a vessel specific sampling plan (VSSP). The VSSP plan must be approved by ADEC before the first sampling event takes place.

The VSSP must demonstrate that the sample will be representative of the wastewater discharged from the particular ship. The General Permit requires onboard sampling locations to be the same as those listed in the current approved VSSP. The VSSP also documents discharge and sample ports, storage tanks, pump flows, and contains a concise description of the wastewater treatment process.

In 2008 and 2009, ADEC discovered numerous errors in the approved VSSPs. The 2010 General Permit requires that VSSPs be both accurate and complete, and reflect the current wastewater treatment and discharge operations. The sampled discharge must match the treatment system, tanks used, and discharge port typically used.

If wastewater is being treated and then stored in holding tanks for a period of time prior to being discharged into marine waters of the state, then that source of wastewater may only be discharged if that effluent is sampled after a typical holding time as indicated in the VSSP.

If wastewater from tanks is mixed with wastewater from the AWTS prior to discharge, a representative sample must match the typical discharge ratios. The mix of graywater and blackwater in the treatment system should also be typical of discharges into marine waters of the state.

Monitoring Requirements

There are monitoring requirements and frequencies associated with all the effluent limits that are stated in Tables 1-7 of the General Permit. Twice monthly sampling is required for ammonia, copper, nickel, and zinc. This is equivalent to the frequency of sampling for these parameters in the 2008 General Permit for permittees who were allowed to discharge under the terms associated with the interim effluent limits.

The General Permit retains the twice seasonal monitoring requirement for other parameters.

ADEC or its contractor may take additional samples in addition to those required in the 2010 General Permit (AS 46.03.465 (c)). ADEC will be allowed access to the vessel for the purpose of taking samples, to verify the integrity of the sampling process, and to verify recordkeeping requirements of the permit (AS 46. 03.462).

The first sampling event for all parameters with effluent limits listed is required within ten (10) days of the first discharge into marine waters of the state.

A cruise ship that is authorized to discharge while underway may only discharge wastewater while the vessel is traveling at least 6 knots. Wastewater samples must be taken while the vessel is underway and is discharging into marine waters of the state. The sample must also be representative of the wastewater that is discharged.

A cruise ship that is authorized to discharge continuously may discharge either while the vessel is docked, anchored, moving at less than 6 knots or while it is underway traveling at a speed of 6 knots or greater. If a cruise vessel that is authorized to discharge continuously chooses to discharge wastewater while docked, anchored, or moving at less than 6 knots at any time during a calendar month, then at least one wastewater sample must be obtained from the vessel while the vessel is docked, anchored, or moving at less than 6 knots during that same month.

Any samples taken while the vessel is docked, anchored, or traveling at a speed of less than 6 knots must comply with the "Daily Maximum Continuous" requirements found in Table 2 through 7 of the General Permit.

The permittee must identify on the Discharge Monitoring Reports (DMRs) whether the vessel is docked, anchored or moving at less than 6 knots or whether the vessel is underway during the sample event.

Reporting Requirements

Calculating averages:

The monthly limit for fecal coliform bacteria must be calculated as a geometric mean. The geometric mean is the N^{th} root of the product of N, where N is the number of samples analyzed. All non-detect sample results will use a value of 1 for calculation of the geometric mean.

Example geometric mean calculation, where N= 4: $\sqrt[4]{12x23x34x990} = 55$.

The monthly average for Biochemical Oxygen Demand (BOD) must be calculated as an arithmetic mean. This is the sum of the sample results divided by the number of samples. All non-detects will use a value of zero for the calculation of the arithmetic mean.

Noncompliance Notification:

A permittee must report all violations of the General Permit within 24 hours of discovery to ADEC. For effluent limit violations that are reported on the DMR, there is no requirement that a Noncompliance Notification form to be submitted to ADEC. The 2010 General Permit does require a Noncompliance Form for accidental discharges, discharges that may endanger health or the environment, or upset conditions of the wastewater treatment system.

Discharge logs:

Discharge logs shall be submitted monthly to ADEC no later than five calendar days after each calendar month in operation in Alaska (AS 46.03.465 (a)). This statutory requirement has not been changed by the issuance of the permit.

Discharge Monitoring Reports (DMR):

- DMRs must be submitted with the effluent limits for the type of wastewater treatment system installed upon the vessel (Table 1 plus applicable limits found in Table 2 through 7 of the General Permit).
- All vessels authorized to discharge under the 2010 General Permit must submit a DMR for the months that the vessel operated in Alaska regardless of whether the vessel discharged or not. If there was no discharge, the DMR should be clearly marked that there was no discharge.
- DMRs are only submitted for those months when a vessel is in marine waters of state.
- Daily flow must be reported on the DMR. This flow can be estimated or metered. If meters are installed, the reported flow rate must be obtained from the meters.
- DMRs must be submitted no later than 21 days following the calendar month in which sampling occurred.
- Non-detects must be reported as ND.

The 2010 General Permit requires that permittees submit electronic copies of analytical results. This requirement allows ADEC to receive sample results in a format which would allow for transfer to current or future recordkeeping and statistical analysis systems. This matches the format that ADEC received sample results from 2004 through 2007. Most of the sample data that was submitted to ADEC in 2008 and 2009 also followed this format.

Antidegradation Analysis

The Antidegradation Policy of the Alaska Water Quality Standards (18 AAC 70.015) establishes the conditions under which the state may authorize any degradation of water quality. That policy applies to this permit.

There are three ascending levels of protection offered by the antidegradation policy. These are commonly referred to as "tiers," even though the regulation itself does not use that term. The level of protection afforded to a particular water body depends upon which tier applies to it.

The lowest level of protection, or tier 1, applies to water bodies whose existing quality is no better than the state-wide water quality criteria for the designated uses of "growth and propagation of fish, shellfish, other aquatic life and wildlife" [see 18 AAC 70.020(a)(2)(C)] and "contact recreation" [see 18 AAC 70.020(a)(2)(B)(i)]. These two uses are often referred to together as the "fishable/swimmable" uses, entitled to particular protection under the federal Clean Water Act.

The next level of protection is tier 2, and it applies to water bodies whose quality is better than the criteria applicable to the fishable/swimmable uses. See 18 AAC 70.015(a)(2). Most water of the state will fall into this category, because the quality of most of our surface waters is higher than the statewide criteria for those two designated uses.

The highest level of protection is reserved for tier 3 waters, which are also referred to as outstanding national resource waters. These waters are entitled to the highest level of protection because they are special for one reason or another. See 18 AAC 70.015(a)(3).

For purposes of this permit, ADEC finds that, at a minimum, all marine waters of the state plied by cruise ships warrant tier 2 protection.

Tier Designations

The marine waters of the state are largely free from man-made sources of pollution and clearly support healthy populations of all variety of fish, shellfish, other aquatic life and wildlife. They also support a variety of forms of recreation including contact recreation defined as activities in which there is direct and intimate contact with the water. Water quality typically surpasses the water quality criteria for "growth and propagation of fish, shellfish, other aquatic life and wildlife" [see 18 AAC 70.020(a)(2)(C)] and "contact recreation" [see 18 AAC 70.020(a)(2)(B)(i)].

There may be certain situations where a particular water quality parameter would indicate a quality less than the criteria associated with these uses. For example, water quality in marine waters heavily influenced by glacial runoff may exceed water quality criteria for turbidity. In these cases, tier 1 protection may be all that is warranted for those parameters in specific areas. Because the situations and areas are believed to be limited and the General Permit is intended to apply broadly to more typical conditions found throughout an area, ADEC has decided for purposes of this permit to provide, at a minimum, tier 2 protections to all marine waters. Any cruise ship that desires a permit more specifically tailored to reflect water quality in certain areas that might warrant a lesser level of protection for certain parameters may apply for an individual permit and provide data to justify tier 1 status.

Tier 3 waters are those that constitute an "outstanding national resource" such as the waters of a national or state park or wildlife refuge *or* other waters with exceptional recreational or ecological significance. There are areas within the geographic scope of this General Permit that may qualify for tier 3 designation and protection. While not within the scope of this permit, the waters of Glacier Bay National Park and Preserve, for example, are clearly waters of a national park and a potential candidate for tier 3 status. The practical effect of excluding Park waters from coverage under this general permit while understanding that wastewater discharges are prohibited by U.S. Park Service entry contracts is the same as extending tier 3 status to these waters.

Tier 3 designations are significant decisions that warrant consultation with land use managers, fish and wildlife agencies and the public. Tier 3 status has significant implications for adjacent and proximal development and land use. ADEC is developing procedures for designating tier 3 waters and intends that final procedures would, at a minimum, undergo substantial public review and, perhaps, involve legislation or legislative approval. Absent final procedures for decision making and with no public comment suggesting tier 3 status, ADEC declined to make any tier 3 designations for purposes of this permit.

Tier 2 Findings

For water bodies slated for tier 2 level protection, limited degradation of water quality can only be allowed when five criteria are met. These criteria and the Department's findings with respect to each follow.

1. Lowering water quality is necessary to accommodate important economic or social development in the area.

While one of many, an October 2000 Report by the McDowell Group and prepared for the Southeast Conference found that "[c]ruise lines, passengers, and crew are estimated to have spent a total of $181 million in the four communities of Juneau, Ketchikan, Sitka, and Haines in 1999. The four communities included in the study, "collected $6.6 million in cruise-related sales tax revenue in 1999." The report goes on to state, "[t]he cruise industry in these four communities directly generated the equivalent of 1,565 year-round jobs in 1999 and a total payroll of $34.5 million. However, the number of individuals earning income from cruise-related employment is significantly higher due to the seasonal nature of the industry. Department of Labor records show that in July of 1999, cruise-related businesses employed approximately 5,100 individuals."

Other reports reach similar conclusions as to the economic benefit derived by these and other coastal communities as a result of the presence of the cruise ship industry. The importance of cruise ships to local economic development is well documented and seems indisputable. ADEC concludes that this criterion is satisfied.

2. The reduced water quality won't violate applicable water quality criteria except as allowed under 18 AAC 70.015(a).

The limits established within the General Permit preclude violating water quality criteria in receiving waters with limited exceptions and then only when the limits are based on mixing zones as provided in 18 AAC 70.015(a). Methods used to derive effluent limits including how the limits assure protection of the most stringent uses are described elsewhere in this fact sheet. ADEC concludes that this criterion is satisfied.

3. *Resulting water quality will fully protect "existing uses."*

By definition, "existing uses" are "those uses actually attained in a water body on or after November 28, 1975." ADEC contends that all uses that existed before 1975 are present today and are protected by water quality standards. Water quality standards protect water quality for aquaculture, seafood processing and industrial uses, for contact and secondary recreation; for growth and propagation of fish, shellfish, other aquatic life, and wildlife; and for harvesting for consumption of raw mollusks or other raw aquatic life. No waters in the permit area have been reclassified to exclude certain uses from water quality standard protection. All uses are present today generally throughout the marine waters of the state covered by this permit, as they were prior to 1975.

The permit requires compliance with water quality standards that protect all uses, including "existing uses" and more, 15 meters of the wastewater discharge ports, and in most cases, much closer to the vessels than that. In particular, discharges from vessels while underway comply with water quality standards much closer to the vessels than 15 meters. Vessels discharging while in port may discharge wastewater that causes water quality standards to be exceeded for certain parameters, such as ammonia, within a 15-meter mixing zone. In order to authorize a mixing zone, ADEC needs to find that the mixing zone will not adversely affect designated and existing uses of a water body as a whole. Existing uses inside and within 15 meters of areas where cruise ships anchor or dock are primarily those related to growth and propagation of fish, shellfish, other aquatic life and wildlife, as well as secondary and contact recreation. ADEC is not aware of other uses occurring in these areas either today or prior to 1975.

Within these limited areas where water quality standards might be exceeded for certain parameters, no impacts on uses are anticipated when discharging vessels are not present. Even when discharging vessels are present, there will be no impacts on recreational use so close to the cruise ships. Similarly, given the small size of the mixing zones and their seasonal and intermittent nature, there will be no impacts on growth and propagation of fish, shellfish, other aquatic life and wildlife. ADEC concludes that this criterion is satisfied.

4. The most effective and reasonable methods of pollution prevention control and treatment will be applied to all wastes and other substances to be discharged.

State statutes that apply specifically to cruise ships require use of "economically feasible methods of pollution prevention, control, and treatment the department finds to be the most technologically effective." [See AS 46.03.462(e) and (f)(1).] This statutory requirement is functionally equivalent to the antidegradation policy requirement for "methods of pollution prevention, control, and treatment found by the department to be the most effective and reasonable." [See 18 AAC 70.015(a)(1)(D).] For reasons described elsewhere in this document, the ADEC has determined that advanced wastewater treatment satisfies the statutory technology standard and, for the same reasons, it satisfies the antidegradation policy criterion. Because the permit requires the use of advanced wastewater treatment systems, ADEC concludes that this criterion is satisfied.

5. Wastes and other substances discharged will be treated and controlled to achieve the highest statutory and regulatory requirements.

The highest statutory requirements applicable to this General Permit are state statutes found at AS 46.03.462(b), (e), (f) and (h). The highest regulatory requirements are found within the various provisions of Alaska's Water Quality Standard regulations at 18 AAC 70. As discussed elsewhere in this document, the General Permit terms and conditions dealing with wastewater treatment and control were derived specifically to satisfy the combined requirements of the above provisions of AS 46.03.462 and 18 AAC 70, with one exception discussed below.

Other applicable statutory and regulatory requirements are found in the Alaska Wastewater Disposal regulations at 18 AAC 72 and in U.S. Coast Guard regulations at 33 CFR Part 159 Subpart E. The permit's treatment and control requirements surpass the minimum treatment and other requirements of the Alaska Wastewater Disposal regulations. With one exception, the permit's treatment and control requirements also surpass those of the U.S. Coast Guard regulations. The exception is that the U.S. Coast Guard regulations require that total residual chlorine in the treated effluent not exceed 10 ug/L which is more stringent than a chlorine limit based on state water quality standards after invoking the mixing zone provision. The permit therefore reflects the more stringent U.S. Coast Guard effluent limit for total residual chlorine as required to satisfy this provision of the antidegradation policy. With this limit, ADEC concludes that this criterion is satisfied.

Acronyms:

ADEC	Alaska Department of Environmental Conservation
AWTS	Advanced Wastewater Treatment System
BOD	Biochemical Oxygen Demand
CPVEC	Commercial Passenger Vessel Environmental Compliance program
DMR	Discharge Monitoring Report
EPA	U.S. Environmental Protection Agency
GP	General Permit
mg/L	Milligrams per liter (approximately a part per million)
QA/QC	Quality Assurance /Quality Control Plan
SU	Standard Units (for pH)
TSS	Total Suspended Solids
µg/l	Micrograms per liter (approximately a part per billion)
VSSP	Vessel Specific Sampling Plan
WQS	Water Quality Standards

Referenced Documents and Information:

Alaska Department of Environmental Conservation
http://www.dec.state.ak.us/index.htm

Commercial Passenger Vessel Environmental Compliance Program
http://www.dec.state.ak.us/water/cruise_ships/index.htm

2008 Large Commercial Passenger Vessel Wastewater Discharge General Permit No. 2007DB0002
http://www.dec.state.ak.us/water/cruise_ships/gp/2008GP_Mod_CPVEC.pdf

2008 General Permit Information Sheet
http://www.dec.state.ak.us/water/cruise_ships/gp/2008_GP_Info2.pdf

CPVEC Cruise Ship Wastewater Sampling and Science Panel Reports
http://www.dec.state.ak.us/water/cruise_ships/reports.htm

House Bill 134
http://www.legis.state.ak.us/basis/get_bill_text.asp?hsid=HB0134Z&session=26

Alaska Cruise Ship Laws and Regulations
http://www.dec.state.ak.us/water/cruise_ships/Law_and_Regs/index.htm

Quality Assurance/Quality Control Plan (QAQCP)
http://www.dec.state.ak.us/water/cruise_ships/pdfs/NWCA%20QAQC%202010%20Final.pdf

2009 ADEC Water Quality Standards (September 19, 2009)
http://www.dec.state.ak.us/water/wqsar/wqs/pdfs/18_AAC_70%20_Amended_September_19_2009.pdf

Water Quality Criteria Manual for Toxics (December 12, 2008)
http://www.dec.state.ak.us/water/wqsar/wqs/pdfs/Alaska%20Water%20Quality%20Criteria%20Manual%20for%20Toxic%20and%20Other%20Deleterious%20Organic%20and%20Inorganic%20Substances.pdf

2004 EMAP (Environmental Monitoring and Assessment Program) Southeast Alaska
http://www.dec.state.ak.us/water/wqsar/monitoring/2004Southeast.htm

ADEC List of Impaired Waterbodies
http://www.dec.state.ak.us/water/wqsar/waterbody/integratedreport.htm

2009 ADEC Assessment of the Stationary Cruise Ship Plume Dilution Study
http://www.dec.state.ak.us/water/cruise_ships/pdfs/2009_Plume_Dilution_Study.pdf

2002 Science Panel "The Impact of Cruise Ship Wastewater Discharge on Alaska Waters"
http://www.dec.state.ak.us/water/cruise_ships/SciencePanel/documents/impactofcruiseship.pdf

U.S. Coast Guard 33 CFR Part 159 Subpart E – Discharge of Effluents in Certain Alaskan Waters by Cruise Vessel Operations can be found at: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=1412c102f876e2bead4561ec68fe80c3&rgn=div6&view=text&node=33:2.0.1.5.28.5&idno=33

ADEC "Feasibility Study: Reducing Concentrations of Dissolved Metals and Ammonia in Large Passenger Vessel Wastewater Discharges," February 16, 2009.
http://www.dec.state.ak.us/water/cruise_ships/pdfs/2_16_09_Feasibility_Report_Draft_Web.pdf

The Economic Impacts of the Cruise Industry in Southeast Alaska, prepared by the McDowell Group, October 2000 found at: http://www.visgroup.org/cruiseimpacts.pdf