MARINE ENVIRONMENT PROTECTION COMMITTEE
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Agenda item 18

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ENGLISH ONLY

ANY OTHER BUSINESS

Shipborne grey water production in the Canadian Arctic: estimates and forecasts

Submitted by WWF

SUMMARY	
Executive summary:	Shipborne grey water production estimates using 2016 ship traffic data for the Canadian Arctic, as well as projected future estimates for 2025/2035 and treatment system options
Strategic direction, if applicable:	2
Output:	Not applicable
Action to be taken:	Paragraph 15
Related documents:	MEPC 60/21/1; MEPC 63/2/18, MEPC 63/23; MEPC 72/16, MEPC 72/16/6, MEPC 72/17, MEPC 72/INF.21; MEPC 73/8/2; DE 54/INF.5, DE 54/13/7 and DE 55/12/3

Introduction

1 Vessel traffic in the Arctic is increasing, in particular, traffic related to resource development and tourism are experiencing significant growth.[1] As sea ice continues to disappear in the Arctic, even more opportunities for the development of the marine sector will present themselves. Shipborne grey water production and discharge is a potential environmental impact of this growth and can be severe to both marine habitat as well as Indigenous and community food security in the Arctic.

2 Vessel grey water is generally considered accommodation (e.g. shower, bath), laundry, dishwasher, and galley wastewater, and is distinct from drainage from toilets, urinals, hospitals and cargo spaces.[2] Wastewater from sinks and deck drains in non-engine rooms,

1 Azzara, A.J., Wang, H. and D. Rutherford. (2015). A 10-year Projection of Maritime Activity in the U.S. Arctic Region. A Report to the President. U.S. Committee on the Marine Transportation System, Integrated Action Team on the Arctic. Washington, D.C.: The International Council on Clean Transportation. *Available at*: http://www.cmts.gov/downloads/CMTS_10- Year_Arctic_Vessel_Projection_Report_1.1.15.pdf

2 *E.g.* Resolution MEPC.219(63), 2012 Guidelines for the Implementation of MARPOL Annex V; 33 CFR 151.05.

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garbage and laundry room floor drains, refrigerator and air conditioner condensate, inter alia, is also routed through the grey water system[3].

3 Vessel grey water constituents and characteristics include microplastics[4], nutrients, elevated temperatures, turbidity, oil and grease, detergent and soap residue, metals (e.g. copper, lead, mercury), bacteria, pathogens, hair, food particles, organic matter, oxygen-depleting substances, suspended solids, bleach, pesticides and phosphates[5]. Pollutants in grey water can contribute to adverse environmental effects such as shellfish contamination[6], algal blooms, hypoxic waters, the smothering of benthic biota (e.g. reef-building corals), and invasive species introductions. These contaminants can also impact economically and culturally important fisheries.

4 While the pollution concentrations, such as biochemical oxygen demand levels and total suspended solids, are often higher in untreated vessel grey water compared to domestic sewage[7], vessel grey water is not regulated internationally. Vessel sewage has been regulated under MARPOL Annex IV since 2003. Various IMO Member States have raised the issue of grey water in the past[8], such as paragraph 2.36 of document MEPC 63/23, where the Committee agreed "that handling of grey water and sewage water on board ships should be regulated under MARPOL Annex IV and invited Parties to propose relevant amendments to that Annex for consideration at a future session of the Committee".

5 The associated impacts of microplastics on the marine environment and its effects on marine biodiversity are receiving increasing attention[9]. For example, at MEPC 72 there was agreement to establish a working group on marine plastic litter and the need for the "development of an action plan to address marine plastic litter from ships in the 2018-2019 biennial agenda of the MEPC, assigning the PPR Sub-Committee as the associated organ, with a target completion year of 2020[10]".

6 To further investigate the issue of grey water, WWF-Canada commissioned Vard Marine Inc. to develop shipborne grey water production estimates using 2016 satellite Automatic Identification System (AIS) ship traffic data for the Canadian Arctic as well as projected future estimates for the quantities and areas of concentration in 2025 and 2035[11].

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3 For some wastewater sources, such as food pulper reject water, there does not appear to be clarity on whether it should be treated as food waste, a MARPOL Annex V regulated waste, or as grey water.

4 E.g. De Falco, F. et al. (2017). *Evaluation of microplastic release caused by textile washing processes of synthetic fabrics. Environmental Pollution* XXX (2017) 1-10, in press (estimating over 6 million synthetic microfibers released from polyester fabrics per wash load); *cf.* Secretariat, LC 39/9/1, 18 Aug. 2017.

5 U.S. EPA (2009). Cruise Ship Discharge Assessment Report, 4-1, EPA 842-R-07-005 [hereinafter EPA Cruise Ship Report]; U.S. EPA (2011). Graywater Discharges from Vessels, 2, EPA 800-R-11-001; U.S. EPA (1999). Technical Development Document for Phase I Uniform National Discharge Standards for Vessels of the Armed Forces, Appendix A, Graywater 5-6, EPA 821-R-99-001.

6 *See* Carlos, J. et al. (2014). Environmental transmission of human noroviruses in shellfish waters. Applied and Environmental Microbiology 80 (2014) 3552-3561.

7 EPA Cruise Ship Report, at 3-9; MEPC 72/INF.21; Alaska Cruise Ship Initiative Part 2 Report. Juneau, AK. "The conclusion that [*sic*] can be drawn from the pollutant concentration data in table 4 [table 2 in MEPC 72/INF.21] is that gray water from commercial vessels has the potential to be as environmentally damaging to surface waters as untreated domestic sewage discharged in similar quantities". EPA 2011, at 9.

8 *See also* Norway, MEPC 60/21/1, 12 Jan. 2010; Norway, DE 54/INF.5, 20 Aug. 2010; Norway, DE 54/13/7, 20 Aug. 2010; New Zealand, DE 55/12/3, 17 Dec. 2010.

9 Document MEPC 73/8/2.

10 MEPC 72/17.

11 Vard Marine Inc. (2018). Canadian Arctic Greywater Report: Estimates, Forecasts, and Treatment Technologies. Prepared for WWF-Canada. Available at: http://d2akrl9rvxl3z3.cloudfront.net/downloads/vard_360_000_01_dfr_rev2_29_05_2018.pdf.

This report builds on a similar Transport Canada report which was completed using 2013 ship traffic data. A summary of the 2018 report is presented in the following sections[12].

Canadian Arctic shipping regime

7 In the Canadian Arctic, the *Arctic Waters Pollution Prevention Act* prohibits the discharge of any "waste", waste being any substance that will have a deleterious effect on the water column[13]. This puts the onus on the operator to prove that grey water does not include any deleterious waste, as defined above, which is extremely difficult. In addition, the discharge of treated grey water will not meet the zero-discharge regime and there is no process for treatment system approval. These regulations require that operators process and discharge grey water before entering a zero-discharge region. However, remaining in the Arctic for an extended period would require the vessels to have very large holding tank systems or for the operator to ignore the regulations and discharge regardless.

Grey water generation estimates

8 A sailing of the Northwest Passage by a large cruise ship (~1000 passengers) is estimated to take approximately 24-28 days assuming a route which leaves from Northern Alaska and exits the Arctic via the Hudson Strait. At even conservative waste production rates, this is still a significant amount of grey water. The carrying capacity of conventional cruise ships may not be sufficient for a voyage of this length. Additionally, fishing vessels will stay at sea for weeks rather than days, and some will have crews of over 20 persons. In many cases, the amount of grey water that is produced will exceed the onboard capacity to carry the waste.

9 Passenger vessels tend to produce more grey water on a per capita basis than cargo and fishing vessels[14]. Based on a 2009 U.S. Environmental Protection Agency (EPA) study[15], the following grey water generation metrics were used to develop the estimates in this report: 253.6 litres per person per day (l/p/d) for all passenger vessels and 125.0 l/p/d for all other vessel types, including cargo and fishing vessels. These generation rates are in line with other sources, for example, the Alaskan Cruise Ship Initiative estimates that cruise ships generate 189 to 246 l/p/d of grey water[16] and the Ocean Conservancy estimates that grey water generation ranges from 114 to 322 l/p/d[17]. The HELCOM Overview 2014 Baltic Sea Sewage Port Reception Facilities report projects black and grey water generation rates of 285.4 l/p/d for cruise ships and 156.8 l/p/d for cargo ships[18].

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12 Vard Marine Inc. (2015). *Projections for Ship-Generated Waste Travelling through the Canadian Arctic*. Prepared for Transport Canada.

13 *Arctic Waters Pollution Prevention Act*. R.S.C., 1985, c. A-12. Current to July 5, 2018. Last amended on April 1, 2014. *Available at:* http://laws-lois.justice.gc.ca/PDF/A-12.pdf

14 This is the case because cruise passengers "are engaged in leisure activities and more likely to use larger quantities of water for bathing, food preparation, etc." EPA 2011, at 6.

15 U.S. EPA (2009). Cruise Ship Discharge Assessment Report, 4-1, EPA 842-R-07-005 [hereinafter EPA Cruise Ship Report]; U.S. EPA (2011). Graywater Discharges from Vessels, 2, EPA 800-R-11-001; U.S. EPA (1999). Technical Development Document for Phase I Uniform National Discharge Standards for Vessels of the Armed Forces, Appendix A, Graywater 5-6, EPA 821-R-99-001.

16 EPA Cruise Ship Report, at 3-3.

17 Hanninen, S. and J. Sassai. (2009). Estimated Nutrient Load from Wastewaters Originating From Ships in the Baltic Sea Area (Research Report VTT-R-07396-08).

18 HELCOM (2015). Baltic Sea Sewage Port Reception Facilities HELCOM overview 2014 - revised second edition. 94 pp. Available at: http://www.helcom.fi/Lists/Publications/Baltic%20Sea%20Sewage%20Port%20Reception%20Facilities.%20HELCOM%20overview%202014.pdf

10 The quantity of grey water generated per km travelled is derived based on the characteristics of the vessel as well as the total time and distance travelled within the Northern Canada Vessel Traffic Services (NORDREG) zone. This also allows for the distribution and concentration of grey water to be presented on a grid or heatmap, which is useful for evaluating which regions are subject to more or less vessel traffic and grey water production, regardless of the capacity or the potential grey water carried onboard. Note that under NORDREG, only vessels of 300 gt or more, vessels towing a combined tonnage of 500 gt or more, or vessels carrying or towing as cargo pollutants or dangerous goods are required to file reports. The satellite AIS data used for this report captures every vessel in the region with an active AIS transponder.

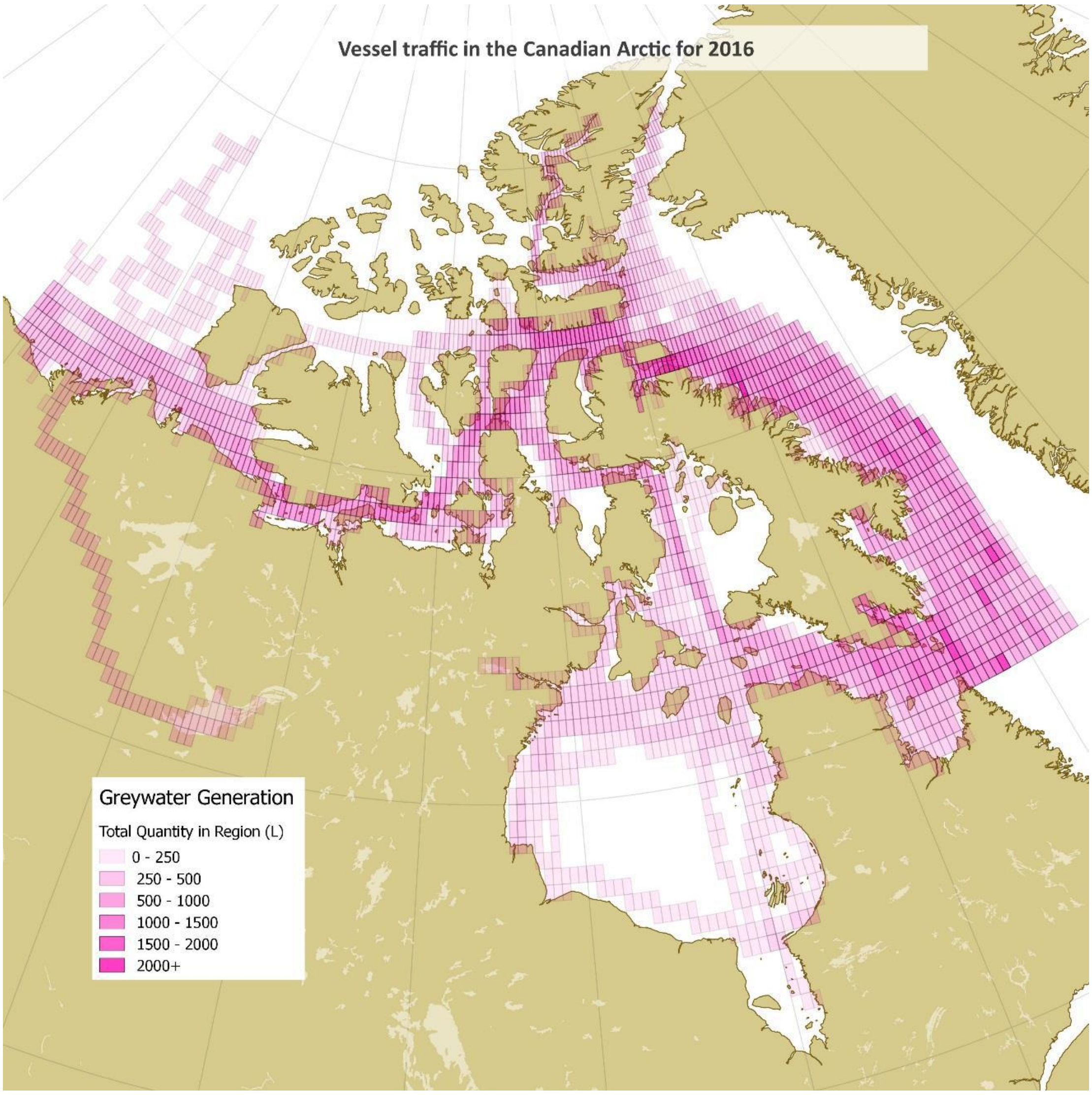

Figure 1. Distribution of grey water production for all vessel types in the Canadian Arctic NORDREG zone in 2016.

Grey water forecast scenarios

11 Forecasts of marine activity in the Canadian Arctic in 2025 and 2035 were determined based on the specific factors influencing each industry sector. Quantities of grey water generated in 2016 were scaled directly as a function of waste generation rate and increased traffic volume.

12 In 2035, grey water production is expected to nearly double in the Canadian Arctic based on 2016 levels. Tourism is projected to be the largest contributor to grey water production. It is expected that passenger vessel traffic will increase by a small number of trips, however, the large number of persons on board will result in a massive increase in grey water production, especially in the Northwest Passage. Mining exports from the Baffinland Mary River project are expected to cause a considerable increase in vessel traffic along the North of Baffin Island which will lead to a significant increase in grey water production in the region. Fishing vessels are also expected to contribute significantly to the amount of grey water generated. This is due to the vessels of the fishing fleet making significantly more voyages than any other type of vessel in the region, and spending over twice as long in the region by number of days than any other type of vessel.

Table 1. Quantities of grey water production within the Canadian Arctic NORDREG zone in 2016 and projected forecasts for 2025 and 2035

Industry Sector	2016 Total (L)	2025 Forecast (L)	2035 Forecast (L)
Tourism	13,460,855	20,778,026	27,422,155
Fisheries	6,266,286	6,892,915	7,519,544
Sealift	5,177,505	5,713,318	6,249,131
Government Operations	4,558,849	4,558,849	4,558,849
Mining	2,680,427	8,036,289	11,168,617
Bulk Shipping	1,066,375	2,132,750	3,169,750
Other	118,161	118,161	118,161
Research	109,833	109,833	109,833
Total	**33,438,293**	**48,340,142**	**60,316,040**

Grey water onboard treatment options

13 Grey water can be treated onboard vessels, either in combination with black water, or separately. While discrete grey water treatment systems do exist, combined systems are the only option that is widely marketed for larger vessels. Combined treatment systems are typically Membrane Bioreactor (MBR) systems, which provide the vessel operator and owners with minimal operating costs, low chemical usages, smallest footprint, low purchase costs, and simple operation. Other types of grey water treatment systems use biological treatments, physical filtration, electrolytic processes, and UV sterilization.

14 Part of any grey water management plan should include best practices for reducing harmful inputs to the system. Harsh chemicals not only jeopardize the effectiveness of many treatment systems, but constitute a pollution risk themselves, and in many cases, are more difficult to fully eliminate from the waste stream than biological matter.

Action requested of the Committee

15 The Committee is invited to take note of the information provided, in particular to note the quantities of grey water production and projected future estimates, and to consider further work in this area and encourage interested States to input similar information.

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