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TECHNICAL MEMORANDUM

Date: June 25, 2015

To: Amy Jankowiak, Washington State Department of Ecology

Copy to: Mark Henley, Washington State Department of Ecology

From: Neil Brauer and Joy Michaud, Herrera Environmental Consultants, Inc.

Subject: Puget Sound NDZ Commercial Vessel Economic Evaluation

Introduction

The Washington State Department of Ecology (Ecology), in coordination with other agencies and interested stakeholders, has been considering petitioning the US Environmental Protection Agency (USEPA) to designate some, or all of Puget Sound a No Discharge Zone (NDZ) for vessel sewage since 2012. Under a NDZ designation, no sewage from any vessels, even if treated by a marine sanitation device (MSD), would be allowed to be discharged in any portion of the area designated as a NDZ. NDZs are regulated at the federal level and overseen by the USEPA, so the state must petition the USEPA to designate a waterbody a NDZ.

There are multiple, legal pathways for justifying a NDZ designation authorized by the Clean Water Act (CWA) Section 312 (f). These pathways are described on the USEPA's NDZ website (<http://water.epa.gov/polwaste/vwd/ndz.cfm>). Ecology is considering a NDZ designation under CWA Section 312 (f) (3), which states: "the State determines that the protection and enhancement of the quality of the waterbody requires greater environmental protection than the current Federal standards allow; and (2) USEPA determines that adequate facilities for the safe and sanitary removal and treatment of sewage from vessels are reasonably available."

In February 2014, Ecology released a draft NDZ petition for public comment. The petition described the environmental need for a NDZ, quantified the recreational and commercial vessel population of Puget Sound, and identified pumpout facilities available to boaters and commercial vessel operators, and implementation strategy. Ecology received over 26,000 comments, with more than 25,000 in support of the draft petition. During the process of evaluating NDZ feasibility and with comments on the draft, some commercial vessel owners, operators, and trade-groups voiced concerns over the potential economic impacts on their operations that would result from a NDZ designation for all of Puget Sound. These concerns were raised in the comment letters received following release of the draft petition to designate Puget Sound a NDZ, and in a series of stakeholder meetings held by Ecology.

The potential ramifications of NDZ designation vary by vessel type, purpose, size, and characteristics of individual vessels. The primary potential impacts to commercial vessels that were identified during the comment period fall into four basic categories: retrofit costs, lost work time, lost revenue from

diminished on-board space, and additional regulatory burdens and costs resulting from vessel reclassification.

Because of those comments, Ecology decided to conduct a limited evaluation to assess some of the assumptions behind the concerns. In 2013 Ecology released a document (Herrera 2013a) evaluating the potential costs and benefits, environmental and economic, of designating Puget Sound a NDZ. This document provided an overview of some of the potential economic ramifications of NDZ designation for Puget Sound for commercial vessel operators. The purpose of this technical memorandum is to provide a more thorough overview and verification of the concerns voiced by tugboat, fishing, and small passenger-vessel owners, operators, and trade groups. Where possible, the costs of retrofitting vessels with holding tanks are identified in the context of national and international regulations. Potential impacts on operations that may result in revenue losses are identified and quantified to the extent possible, given very limited access to available data. Lastly, publically available revenue data for tugboats, fishing vessels, and small passenger vessels is presented to provide context for the potential economic impacts that would be experienced by each vessel group.

Holding Tank Requirements and Direct Retrofit Costs

Holding tanks must meet United States Coast Guard (USCG) regulations, and, in certain cases, International Convention for the Prevention of Pollution from Ships (MARPOL) standards as well. Any holding tank retrofit must take applicable regulations in terms of sizing and construction into account. Depending on the amount and type of available space on the vessel, adding a holding tank may be relatively straightforward; or it may involve significant design, engineering, stability testing, and load line recertification to ensure the vessel's seaworthiness following retrofit. In most cases, the cost of the retrofit is related to the size of the holding tank installed. The following subsections identify holding tank requirements and potential direct costs for each of the vessel groups.

Regulatory Requirements for Holding Tanks

Sewage from ships is regulated by both national and international laws. Nationally, sewage from vessels is regulated by Section 312 of the Clean Water Act (CWA), and enforced by the USCG. MSDs, which include holding tanks, are regulated under federal code (i.e., 33 CFR 159). Internationally, sewage from ships is regulated by MARPOL Annex IV. MSDs, specifically, are regulated under MARPOL Annex IV regulation 9. The United States has not ratified MARPOL Annex IV; however, "vessels registered in the United States visiting nations that are party to MARPOL Annex IV may need to demonstrate compliance with MARPOL Annex IV regulations for the prevention of pollution by sewage from ships" (USCG 2013). Therefore, ships that might foreseeably operate within Puget Sound as well as internationally would need to comply with national and international regulations. Vessels registered in the United States that engage in international voyages with sewage systems in compliance with MARPOL Annex IV may receive a Statement of Voluntary Compliance (SOVC).

All MSDs installed on United States ships must be USCG certified. Since Type III MSDs (holding tanks) do not treat wastewater, the only USCG standards governing them relate to holding tank capacity. Federal code does not mandate holding capacity, but the USCG does provide holding tank sizing recommendations (USCG undated). MARPOL sewage regulations also do not dictate sizing requirements; rather, the following language is used: "vessels without a treatment device must have a

holding tank of the capacity to the satisfaction of the Administration for the retention of all sewage, having regard to the operation of the ship, the number of persons on board, and other relevant factors. The holding tank shall be constructed to the satisfaction of the Administration and shall have a means to indicate visually the amount of its contents." The USCG Marine Safety Center (MSC) may issue SOVCs for vessels with devices compliant with MARPOL Annex IV if it is a USCG Type III certified device (USCG 2013). Therefore, vessels with USCG-approved holding tanks are effectively MARPOL compliant.

Tugboat Retrofits

Approximately 150 tugboats operate within Puget Sound (Herrera 2013b). About half of these tugboats are mid-sized (75 to 125 feet); the remainder are approximately equally divided between small (22 to 75 feet) and large [greater than 125 feet] tugboats). In general, mid-size and larger tugboats, representing about half of the tugboat fleet, are oceangoing, while the smaller tugboats (harbor tugs), remain on inland waters. There are a diverse range of operational profiles for tugboats, with some tugboats operating nearly 24 hours over 7 days per week, and some returning to port daily. According to the American Waterways Operators (AWO), the national trade organization for tugboats, website (<americanwaterways.com>): "Tugboat and towboat crews work varying schedules, but most crews live aboard the vessel for two to four weeks and then have one to three weeks off. In most segments of the towing industry, crewmembers stand two 6-hour watches daily. Crewmembers on some harbor tugboats go home at night and often work a single 12-hour shift." The number of crew aboard and the operational profile of a tugboat affect the rate at which sewage is generated, and the feasibility of holding and pumping waste. Currently about 25 percent of the tugboat fleet based out of Puget Sound utilizes holding tanks; the rest have Type II MSDs that treat and discharge waste (Charlie Costanzo, Vice President-Pacific Region, AWO, personal communication, November 2013).

AWO provided their own detailed estimate of the costs of retrofitting tugboats with holding tanks in a response letter to the draft NDZ petition (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, April 2015). For the purposes of their estimate, they assumed that a typical trip length (without returning to port) ranges from 14 to 21 days, and typical crew sizes range from four to eight. Based on these assumptions, AWO estimated that tugs would need to be retrofitted with minimal tank sizes ranging from approximately 1,100 to 2,900 gallons to accommodate the waste generated during longer trips (Table 1) based on ClassNK (an international vessel classification agency) guidelines (ClassNK 2003). Note: Minimum tank size is calculated by first calculating the required capacity and then adding 25 percent to allow adequate buffer to minimize spill risk. Required capacity was calculated assuming conventional plumbing is used resulting in a waste generation rate of about 16 gallons per person per day.

Table 1. Tank Size Estimates Provided by AWO.

Crew Size	Days	Required Capacity at 75% (gallons)	Minimum Tank Size (gallons)[a]
4	14	887	1,109
7	14	1,552	1,940
7	21	2,328	2,911

[a] Holding tank estimates based on ClassNK technical guidelines (ClassNK 2003), and provided by AWO (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, April 2015).

The estimate provided by AWO for holding tank capacity is based upon current vessel plumbing and configurations, but could be substantially reduced if more efficient heads were installed. For conventional plumbing systems the USCG estimates a waste generation rate of about 26 gallons per person per day (ppd) for a live-aboard crew (Table 2), which is higher than the 16 gallons ppd estimate used by AWO. However, there are more efficient head types that use far less water and therefore have a much lower waste generation rate (Table 2.), which would require far smaller holding tanks.

Table 2. Waste Generation Rate for Live-Aboard Crew Based on USCG Guidelines.[a]

Conventional (gallons ppd)	Recirculating (gallons ppd)	Vacuum (gallons ppd)	Hand Pump (gallons ppd)	Electric (gallons ppd)
25.2	0.5	1.9	2.9	5.4

[a] Waste generation rates were reported in liters in USCG Undated. Values were converted to gallons to maintain consistency with other waste generation rates provided.

According to AWO, the high efficiency heads are more costly to install and maintain, and may not be durable enough for daily use on tugboats (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, May 2015). Based on these concerns some additional contacts were made with head manufacturers. While some of the more efficient heads may be less reliable due to delicate moving parts, mechanical macerators, and complex plumbing systems, it appears that reasonable options suitable for use in a commercial environment are available. For example, one of the heads researched has no moving parts, costs about $2,000 to install, connects to a holding tank or treatment device with standard piping, and comes with a 5-year warranty. This particular system uses about 1 gallon per flush, which would result in about a 6-gallon ppd waste generation rate, so it is not among the most efficient systems available, but is still many times more efficient than conventional systems (Scott Mulligan, Senior Sales Engineer, Headhunter Inc., personal communication, June 2015). Another head researched is an air-assisted toilet that uses about 0.5 gallons per flush, which would correspond to about a 2-gallon ppd waste generation rate. This head is available for about $1,500, and comes with a 2-year warranty. The company's website has a list of several hundred commercial marine customers including tugboats, passenger vessels, and freight vessels (Microphor 2015).(The two low-flush heads described here were not included in the USCG guidelines and are therefore not included in Table 2.)

Composting and incinerating toilets are considered approved Type III MSDs by the USCG, which could alleviate pumpout needs altogether. These do not appear to be commonly used on commercial vessels based on this research. However, they may be a viable means for bringing a vessel into compliance with NDZ regulations without incurring the significant retrofit costs associated with adding a holding tank.

Clearly, necessary holding tank capacity is dependent on crew size, trip length, and the type of head installed. Crew sizes on tugboats cannot reasonably be reduced; and there are business and operational concerns beyond the scope of this report that would need to be known to assess, specifically, whether shortening trip lengths would be a reasonable approach for some tugboats. As documented in Table 2, the most significant method for reducing holding capacity needs would be converting to a different head type. (Holding tank volumes would be substantially reduced from those estimated in Table 1. For example, the required holding tank capacity for a crew of four with a 14-day trip [the first scenario in Table 1], for the low-flush heads discussed above would be about 420 and 140 gallons, respectively. For a crew of seven and a 21-day trip [the third scenario in Table 1] the required capacity would be

1,100 and 368 gallons, respectively. These scenarios represent a 62 and 87 percent reduction in required holding capacity compared to the AWO estimate.)

Oceangoing tugs, by necessity, have longer duration trips, but only a small part of the time is spent in Puget Sound. If these tugboats were to rely solely on a holding tank for their waste management needs, they would require a large capacity holding tank consistent with the estimates in Table 1 or the paragraphs above. However, vessels are not limited to using only one type of MSD; and vessels with holding tanks may still have a functioning Type II (treatment type) MSD that can be used when operating outside of the NDZ. This would greatly reduce holding capacity needs.

Since about half of the tugboat population, or about 75 tugboats (Herrera 2013b), operates only locally, it would seem reasonable to assume that these vessels could have much smaller holding tanks because of their relative proximity to pier-side pumpout services. However, even though local tugboats are often operating close to ports, or in some cases within ports, it may not be practical or cost efficient for them to stop to pump out. Therefore, having a very small sewage holding capacity that dictates frequent stops would likely limit each fleet's flexibility and ability to respond to client needs.

In practice, decisions on required holding tank size would be made for individual tugboats. However, there are tugboats currently working in Puget Sound that return to port daily and could and do pump out frequently, without significant interruption to their operations (B. Campbell, Owner, Campbell Maritime, personal communication, April 2015). There are also a number of oceangoing tugs which already use holding tanks as opposed to Type II MSDs (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, November 2013).

Several shipyards and tugboat operators were contacted in an attempt to obtain information on retrofit costs. The shipyards were unable to provide even a general cost range for retrofits because of the high cost variability resulting from the unique challenges of each vessel. What is clear, based on these conversations, is that installing large holding tanks on tugboats is logistically challenging due both to space limitations and stability considerations (C. Costanzo, Vice President-Pacific Region, AWO; J. Slesinger, Safety and Training, Western Towboat; D. Dixon, Naval Architect, Dixon Marine Surveys; personal communications, April 2015). Additionally, unless the holding tank is placed within an existing closed space within the hull of the vessel, the vessel would need to undergo load length certification as required by federal code 46 CFR 42.09-50. This would add significant cost if done outside of the 5-year recertification cycle (vessels must be dry-docked so that the underwater hull, sea chests, and valves can be inspected before a new load-line length certificate can be issued) as specified in 46 CFR Subchapter E. The estimated, line-item costs of retrofitting a tugboat with a 3,000-gallon capacity holding tank, sufficient for a crew of seven on a 14-day trip (Table 1), are outlined in Table 3.

Table 3. Estimated Holding Tank Retrofit Costs of Tugboats.

Action	Cost[a]
Naval architect for design work	$25,000
American Bureau of Shipping (ABS) survey	$14,000
Steel: 1,500 lbs. @ $25/lb.	$37,500
Coating system for new and disturbed internal steel	$20,000
Dry-dock fees to repair hull coatings disturbed by hot work on steel	$35,000
	Total Cost $161,500

[a] Cost estimates provided by AWO in their response letter to the Draft NDZ petition (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, April 2014).

Foss Maritime, which operates two Puget Sound shipyards, and conducts their work in house, also provided a minimum retrofit estimate of $125,000 per vessel. Both AWO and Foss indicated that retrofit costs could be substantially higher if space limitations required significant vessel reconfiguration.

Adding very small holding tanks, similar to those installed on recreational vessels, to tugboats is a much simpler and less expensive task. A representative from Campbell Maritime (B. Campbell, Owner, Campbell Maritime, personal communication, April 2015), a small tugboat company, stated that all of their tugboats were outfitted with 50- to 100-gallon holding tanks, simply because they were less expensive than a Type II MSD. No information was available related to the cost of these retrofits except that they were not "a memorably significant cost." These small holding tanks were appropriate for Campbell's vessels since their crew returns to port daily. Small tanks such as those installed on Campbell's tugboats would only be appropriate for vessels with a similar operational profile.

For tugs that require major retrofitting for large capacity tanks, the design and construction costs provided by AWO and FOSS maritime could not be independently verified; however, in the context of replacement cost and annual maintenance costs, the cost estimates for a major redesign seem appropriate. The US Army Corps of Engineers (USACE) estimated the 2004 full vessel replacement cost of tugboats ranged from about $450,000 for small harbor tugs to about $11,500,000 for the largest tugs. The annual maintenance and upgrade cost (i.e., non-fuel cost to keep the boat safe, operational, and certifications up-to-date) was estimated to be about $100,000 to $300,000 (USACE 2004) for the same vessel groups.

About 95 of the approximately 150 Puget Sound tugboat fleet would need to be retrofitted (C. Costanzo, Vice President-Pacific Region, AWO, personal communication, November 2013). A conservative cost estimate, assuming that all 95 tugboats would require installation of a 3,000-gallon holding tank at an estimated cost of $161,500, would represent a 15.3 million expenditure for this sector. It is likely that smaller holding tanks could be installed on some vessels by using more efficient heads or by modifying operational profiles to be able to pump out more frequently. Smaller holding tanks could potentially be less expensive to install. Despite substantial retrofit costs, tug operators in other recently established NDZs, such as Boston Harbor, have successfully retrofitted tugboats without serious disruption to operations (T. Callaghan, Massachusetts Office of Coastal Zone Management, personal communication, April 2015).

Fishing Vessel Retrofits

There are about 350 fishing vessels that operate on Puget Sound (Herrera 2013b). About 70 of these vessels are salmon seiners that fish in Puget Sound for part of the year. The remaining majority of the fleet berths in Puget Sound ports (e.g., Anacortes and Fisherman's Terminal in Seattle), and fishes outside of Puget Sound, typically in Alaska, for most of the year. As with tugboats, holding tank capacity requirements would likely be different between vessels that primarily remain on Puget Sound, and those that only move through Puget Sound on their way elsewhere. Vessels that only work in Puget Sound may only require a small holding tank because they are typically only away from port for 1 to 2 days, and there are available dockside services that could replace the need for large holding tank capacity. Oceangoing vessels would need larger holding capacity if they were to rely solely on a Type III holding tank for all of their sewage management needs. However, as was noted for the tugs, vessels are only required to hold waste while within the NDZ; and these vessels could continue to use a Type II MSD

outside of the NDZ. For vessels that primarily transit through Puget Sound for short periods of time, this strategy could alleviate the need for a large holding tank.

Logistically, retrofitting a fishing vessel with a holding tank may be easier than retrofitting a tugboat because there is more available space. However, available space is likely in an existing fish hold, and would mean that the vessel would not be able to store the same volume of fish (D. Dixon, Naval Architect, Dixon Marine Surveys, personal communication, April 2015).

The individual characteristics of each fishing vessel would dictate the cost of retrofits. As with tugboats, there is a wide range of potential holding tank retrofit costs that would depend upon vessel size, purpose, crew size, trip length, and areas of operation. Trident Seafoods, in their response to the draft NDZ petition, provided a cost estimate range of $175,000 to $350,000 per vessel for retrofitting the remaining 14 vessels of their fleet of 42 that do not already have holding tanks (S. Stokes, Environmental Compliance Director, Trident Seafoods, personal communication, April 2014). A naval architect at Pacific Fisherman Shipyard in Seattle indicated that the cost range of retrofitting fishing vessels with holding tanks would range from about $35,000 to $150,000 (D. Dixon, Naval Architect, Dixon Marine Surveys personal communication, May 2015). The total retrofit cost including design, materials, and construction was $35,000 for placement of a 125-gallon holding tank on a 108-foot standard crabber with a crew of five. (D. Dixon, Pacific Fishermen Shipyard, personal communication, May 2015).

It is unknown how many fishing vessels would need to be retrofitted, and there is potentially a wide range of retrofit costs specific to each vessel. Based on survey information collected in 2013 (Herrera 2013b), and information provided by Trident Seafoods (S. Stokes, Environmental Compliance Director, Trident Seafoods, personal communication, April 2014), approximately one-third to one-half of the approximately 350-vessel Puget Sound fishing fleet would need to be retrofitted with holding tanks. Since it is uncertain how many vessels would need retrofitting, and the extent of required retrofits, an industry-wide cost was not estimated.

Small Passenger Vessel Retrofits

Broadly defined, small passenger vessels are vessels smaller than 100 gross tons (GT) and carry fewer than 150 passengers at any time, or fewer than 100 overnight passengers. In Puget Sound this designation of vessel includes whale watching tours, dinner cruises, and small overnight cruises. The specific number of small passenger vessels was not calculated in Herrera (2013), because vessels qualifying as small passenger vessels would have been included in multiple different vessel groups such as “cruise ship,” “sail whale,” and “passenger ship.” Calculating the number of small passenger vessels is beyond the scope of this technical memorandum. Based on comments received, the small passenger vessel sector potentially most affected by NDZ designation appears to be small overnight cruise ships that carry close to 100 passengers, which represents a population of about eight vessels.

Small passenger-vessel holding-tank needs are quite different than fishing vessels or tugboats due to having many more people on board. Whether the vessel is used for overnight passengers or day trips also affects holding tank size needs. One overnight passenger vessel owner estimated that an appropriately sized holding tank retrofit would cost approximately $650,000 per vessel (A. Jankowiak, Washington State Department of Ecology, personal communication, October 2014). No other cost estimates were provided by the industry or specific vessel owners, and no shipyard estimates could be obtained due to the highly variable vessel types and needs.

It may be possible to add comparatively small holding tanks to some small passenger vessels, though this possibility would need to be evaluated on a case-by-case basis (T. Voss, Vice President, Un-Cruise, personal communication, June 2015). Several of the small passenger vessels that operate on Puget Sound are only within the proposed boundaries of the NDZ for a short period of time, so it is possible that a smaller holding tank could be sufficient for the time the vessel spends in Puget Sound. For vessels that operate almost solely on Puget Sound, as is the case for one of the vessels operated by Un-Cruise, pumpout facilities would need to be available at every port of call, for a smaller holding tank to be adequate (J. Leahy, Marine Compliance Administrator, Un-Cruise, personal communication, June 2015). The cost and feasibility of adding smaller holding tanks (e.g., in the 5,000- to 7,000-gallon range) to small passenger vessels would need to be evaluated on a case-by-case basis

As more pumpouts become available, revenue losses due to time spent traveling to pumpouts and related fuel expenses should decrease. Less costly options for waste disposal may also become available. Currently, most commercial vessels with large holding tanks (e.g., the tugboats in the scenarios proposed by AWO in Table 1) would likely rely on pumping trucks. FloHawks, a pumping service that serves the Seattle-Tacoma area, quoted a pumping price of 33.5 cents per gallon, for pump outs over 1,000 gallons. This estimate includes truck time and all other related expenses. At this rate, pumping a 3,000-gallon holding tank would cost a little more than $1,000 and recur every 2 to 3 weeks based on the proposed waste generation rates in Table 1. Eventually there may be more land-based pumpouts available. Ecology is currently working with stakeholders to determine the best locations for these facilities and exploring funding options.

A final factor that could also make a significant impact to holding capacity and pumpout problems is the availability of appropriately designed mobile pumpout boats. If more of these were available in the right places there would be less “lost time” traveling into port to pump out.

The financial effects from time lost and fuel costs resulting from pumpout trips may be substantially smaller for other companies. For boats that do shorter jobs and return to port frequently, pumping out may not result in much additional operating cost, as they can call on one of the pumpout boats that service recreational vessels and schedule pump outs coincident with return trips. (B. Campbell, Owner, Campbell Maritime, personal communication, April 2015)

Indirect Costs of NDZ Regulations

Retrofitting vessels with holding tanks, and complying with NDZ regulations (i.e., pumping out instead of discharging treated waste) potentially poses additional expenses or revenue losses to commercial vessel groups beyond the direct cost of adding a holding tank. The purpose of the following subsection is to provide an overview of these impacts for each of the three vessel groups.

Tugboats

For tugboats, assuming that the holding tank added to a tugboat is of sufficient capacity to allow for job flexibility and reasonable trip length, there is no other loss of vessel functionality in terms of loss of cargo or passenger space. However, the time spent navigating to and from pump-outs and pumping out, could represent a loss in revenue due to lost work time. As an example, Western Towboat, a mid-sized tug company that operates tugboats in Puget Sound and Alaska, operates their tugs 24 hours a day, 7 days a week. Each boat generates between $600 and $2,000 per hour in revenue, so time spent

performing pump-out related activities represents a direct revenue loss (J. Slesinger, Western Towboat, personal communication, April 2015). Additionally, fuel would be consumed navigating to and from pump-out facilities that would otherwise be used for typical tugboat operations. Thus, assuming a half-day loss for each pump-out event, the direct revenue loss per event would be $2,400 to $8,000 not including fuel. However, it should be noted that if pump outs were scheduled to occur concurrently with refueling events, these would not represent significant additional operating costs. However, for this to work, pump-out facilities would need to be located at commercial fuel docks. Fueling schedules vary for different tugboats. For example, a ship-assist tug might fuel weekly or twice monthly, while a line-haul tugboat might only fuel once per month (M. Curry, Global Marine Transportation Inc., personal communication, May 2015). Sizing the vessel's holding tank to be able to hold waste for the typical duration that the vessel operates between refueling may be a good strategy for ensuring that extra trips do not need to be taken for the sole purpose of pumping waste.

As more pump-outs become available, revenue losses due to time spent traveling to pump-outs and related fuel expenses should decrease. Less costly options for waste disposal may also become available. Currently, most commercial vessels with large holding tanks (e.g., the tugboats in the scenarios proposed by AWO in Table 1) would likely rely on pumping trucks, though additional stationary pumpouts are in the process of being added. Smaller commercial vessels could also use mobile pumpouts. FloHawks, a pumping service that serves the Seattle-Tacoma area, quoted a pumping price of 33.5 cents per gallon, for pump outs over 1,000 gallons. This estimate includes truck time and all other related expenses. At this rate, pumping a 3,000-gallon holding tank would cost a little more than $1,000 and recur every 2 to 3 weeks based on the proposed waste generation rates in Table 1.

The financial effects from time lost and fuel costs resulting from pump-out trips may be substantially smaller for other companies. For boats that do shorter jobs and return to port frequently, pumping out may not result in much additional operating cost, as they can call on one of the pump-out boats that service recreational vessels and schedule pump outs coincident with return trips. (B. Campbell, Owner, Campbell Maritime, personal communication, April 2015)

Commercial Fishing Vessels

Indirect expenses of vessel retrofits for commercial fishing vessels would primarily result from the loss of fish hold volume and load carrying capacity. Unlike tugboats, lost time due to pumpout activities may be less of an issue as fishing vessels working in Puget Sound would routinely make regular trips to offload fish, when presumably the holding tank could be pumped. Similarly, transient vessels likely can get by with smaller holding tanks since they would only be in Puget Sound for a day or two and could discharge out at sea.

Retrofitting a fishing vessel with a holding tank would typically involve converting fish hold space into holding tank space. (D. Dixon, Naval Architect, Dixon Marine Surveys, personal communication, May 2015). It is common for fishing boats on return trips to have holding tanks filled to capacity with fish. Therefore, an important indirect cost to fishing vessels is associated with loss of fish holding space; thus, the loss of fish hold capacity would reduce the profitability of each fishing trip. Another concern associated with this vessel group is vessel stability. Fully loaded fishing vessels often have very little freeboard; and the added weight of a full sewage holding tank, depending on size and location of the tank, could result in an increased rollover risk (D. Dixon, Naval Architect, Dixon Marine Surveys, personal communication, May 2015).

Another potential indirect cost of retrofitting fishing vessels is the requirement of load-line length certification. Load-line length is the length of the vessel at the waterline at a particular draft. Certifying a maximum load-line length helps ensure that a ship will retain reserve buoyancy and adequate stability when fully loaded. Fishing vessels built prior to 2013 are exempt from load-length certification, but newer vessels must undergo load-length certification. However, federal code states: "An existing vessel, which had a load line assigned under previous regulations which undergoes repairs, alterations, or modifications of a major character, shall meet the requirements for a new vessel in this part insofar as the assigning and issuing authority and the Commandant deem reasonable and practicable." Therefore, it is possible that retrofitted fishing vessels built prior to 2013 that previously did not require a load-length certification would need to be certified following retrofits, and as a result, may be restricted in the amount of cargo (fish) they may carry following load-line length certification.

During previous information gathering efforts (Herrera 2013b), Puget Sound fishing vessel owners and operators were surveyed about sewage handling practices. Based on the survey responses received, about half of the vessels identified had holding tanks, but a very small number of responses were received so it is not clear if this is representative of most commercial fishing vessels. In their response to the draft petition, Trident Seafoods stated that 28 of their 42 vessels already had holding tanks, so a best guess is that about half of the Puget Sound fishing fleet is already using holding tanks and would not need to retrofit their vessels. Based on the fact that holding tanks are apparently commonly found on commercial fishing vessels, it seems that fishing vessels can remain both safe and profitable, and use a holding tank. However, as with the other vessel types, safety and feasibility would need to be evaluated on a case-by-case basis.

Small Passenger Vessels

Indirect costs to this commercial group include lost revenue due to decreased cabin or passenger space, and potential regulatory impacts. As stated previously, due to the much higher passenger numbers associated with this commercial group, the size requirements for holding tanks are high, which makes the logistical considerations of adding a holding tank potentially more challenging than for the other commercial vessel groups.

Several small-vessel owners raised concerns that some of the vessels they owned would simply be impossible to retrofit because the large (approximately 20,000 gallon) holding tanks would severely compromise the ship's stability. For example, the National Geographic Sea Bird and Sea Lion ships, operated by Lindblad Expeditions, cannot be retrofitted with an appropriately sized holding tank due to stability concerns according to the naval architect they consulted (D. Stevens, Lindblad Expeditions, personal communication, October 2014). Thus, an unknown number of these vessels would need to be completely replaced or go through a major remodel, thought to be cost prohibitive and limiting to future revenue generating potential of the vessel.

For those small passenger vessels that can be retrofitted, adding holding tanks may cause a substantial increase in the "enclosed volume" on the vessel, which would increase the gross tonnage (GT), potentially resulting in reclassification of the vessel. Passenger vessels under 100 GT have substantially fewer restrictions regarding vessel design, stability testing, inspection frequency, and crew training requirements. These factors make it more cost effective to operate a passenger vessel that is under 100 GT compared to a similarly sized vessel that is just over the 100 GT limit. It is common for passenger vessels to be designed specifically to stay below the 100-GT cutoff. Several of the small passenger

vessels that operate within the proposed NDZ are very close to 100 GT in size. For these vessels, adding a holding tank would likely result in reclassification; and according to vessel owners, this would be cost prohibitive to their operation. It may be possible to retrofit small passenger vessels and keep them under 100 GT, but these retrofits would likely come at the expense of cabin space, reducing the vessel's revenue generating potential (A. Jankowiak, Washington State Department of Ecology, personal communication, October 2014)

The potential economic impact on vessels that cannot feasibly be retrofitted or replaced is that they would not be able to include areas designated as NDZs as part of their itineraries, which could affect the marketability of their cruises. Un-Cruise, for example has a 7-day itinerary that is entirely within Puget Sound that has become very popular in the past few years (J. Leahy, Marine Compliance Director, Un-Cruise, personal communication, June 2015). The majority of small passenger vessels, however, spend most of their time in Alaska (A. Jankowiak, Department of Ecology, personal communication, June 2015); but the ability to operate in Puget Sound allows small passenger vessel companies to lengthen their operating season in the Pacific Northwest (T. Voss, Vice President, Un-Cruise, personal communication, June 2015). As stated earlier, under certain circumstances it is possible for vessels to add smaller holding tanks that may be adequate for short duration trips within Puget Sound. However, the economic feasibility of this has not been evaluated. Some of the small passenger vessel companies that operate on Puget Sound own vessels that have holding tanks, but the vessels are used in other locales. It may be possible for these companies to switch itineraries such that their boats with holding tanks can be used in Puget Sound (A. Jankowiak, Department of Ecology, personal communication May 2015).

According to the small vessel owners and operators that attended a meeting with Ecology in October 2014, most small passenger vessels operate on very small profit margins and rely on full bookings to remain profitable. Large-volume holding tank installations may come at the expense of passenger or cabin space, which would limit the revenue-generating potential of each vessel.

Economic Context

A NDZ designation for Puget Sound will result in some one-time and recurrent costs for vessel owners and operators. It is valuable to view these expenses within the context of the overall economic setting of their respective industries.

Ideally, the information presented on the direct and indirect costs of complying with the NDZ regulations would be put into context against long-term capital costs and the typical operations and maintenance costs associated with vessels in each industry. However, the vast majority of the affected vessels are owned by private entities, and information on gross revenue and profit is largely unavailable. The information presented in the following section was obtained from public records, published industry reports, and financial information published or provided by individual companies. The estimates provide a gross level perspective on the relative cost to the industry of completing retrofits and meeting NDZ regulations.

Tugboats

Washington statewide revenue for the tugboat industry, which includes, salvage, docking, harbor tugboat services, piloting services, and tugboat services, was approximately $301 million (WDOR 2015).

Some portion of this revenue is attributable to tugboats based outside of Puget Sound, such as in the Columbia River, Grays Harbor, and other coastal ports.

The size of tugboat companies that operate in Puget Sound range from small to very large. An example of a small company would be Campbell Maritime, which operates four tugboats, almost exclusively within Puget Sound. At the opposite end of the spectrum, Foss Maritime, operates more than 200 tugboats worldwide and has homeports on every continent (Saltchuk 2015). In the middle are companies such as Western Towboat, which operates 21 tugboats in Puget Sound and in Alaska. Foss' gross annual revenue was reported to be more than $430 million (Saltchuk 2015), which would equate to an annual revenue of about $2 million per boat. Calculated differently, assuming that a tugboat does paid work for 12 hours a day, 365 days a year at a rate of $600 to $2,000 per hour, annual revenue would be $2.6 million to $8.7 million per boat. The daily operating cost of a tugboat ranges from between about $1,500 to about $5,600 (USACE 2004), which would account for an annual operating cost, assuming the tugboat is operated 340 days per year, of $510,000 to $1.9 million. The daily and annual estimates include all operating costs including replacement, maintenance, fuel, crew, insurance, and all other expenses.

Such estimates provide a very gross level perspective on the relative cost to the industry of performing these retrofits and meeting NDZ regulations. Equipment costs, such as those related to direct retrofit costs, are long-term investments and would need to be evaluated over the lifespan of the vessel. In addition, the indirect costs that would affect a vessel's per-trip profitability would need to be evaluated against the normal operations costs for each vessel. These estimates can only be confidently evaluated with access to detailed private industry data.

Commercial Fishing

Washington statewide revenue for commercial finfish was approximately $160 million in 2013. Statewide revenue for shellfish, which includes crabs and clams, was about $44 million (WDOR 2015). Based on this revenue estimate and dividing by the 347 fishing vessels in Puget Sound (Herrera 2013), a gross estimate of the approximate revenue generated per vessel per year would be $575,000. A substantial number of Washington-based fishing vessels participate in fishing activities within and outside of Washington State and may therefore generate additional revenue that would not be included in this estimate. Very few commercial fishing companies are publicly traded or otherwise report revenue. However, in a recent Alaska labor statistics report the annual revenue for Trident Seafoods, based in Seattle, was over $1 billion in 2008 (Alaska Department of Labor and Workforce Development 2008). However since Trident Seafoods does not derive its revenue exclusively from fishing, annual revenue attributable to each of its 42 vessels cannot be calculated. Since many vessels sell their fish outside of Washington State, the actual revenue per vessel may be substantially higher for at least some portion of the commercial fishing fleet based out of Puget Sound.

Small Passenger Vessels

Washington statewide revenue for small passenger vessels was approximately $144 million in 2013 (WDOR 2015). This revenue was generated by the industry sector that includes scenic and sightseeing transportation; charter fishing; and whale watching, sightseeing, and dinner cruises. Some of the revenue attributable to charter fishing may be generated on "six pack" vessels, which are uninspected small passenger vessels, and were specifically not discussed in this report. Like the tugboats and fishing

vessels, the revenue reported is also statewide, and would include revenue generated outside of Puget Sound, although in this case that would likely represent a small part of the total for this industry group.

The majority of small passenger vessel companies are private entities, so annual revenue could not be obtained from public records. However, Lindblad Expeditions recently merged with Capitol Acquisition Corp., a publicly traded company. Capitol Acquisition Corp. recently raised $200 million in an initial public offering (IPO) in May 2013 (Baran 2015), and the merger between Capital Acquisition Corp. and Lindblad Expeditions was valued at $439 million (NASDAQ 2015).

Another company profile we were able to obtain was that of Un-Cruise. Un-Cruise has eight vessels and employs 345 people. Annual gross revenue for Un-Cruise is approximately $45 million. Annually, about $8.7 million is spent on wages and $6.5 million in maintenance in addition to other significant expenses such as insurance and fuel. The proportion of the company's revenue or expenses that is attributable to Puget Sound itineraries wasn't readily calculable (T. Voss, Vice President, Un-Cruise, personal communication, June 2015).

There is no clear connection between a company's value and its expected revenue or profits, so gross profit information provides a limited perspective on the NDZ discussion. It is also not possible to determine from public records what portion of each company's revenue may be generated in Puget Sound.

The requirement to retrofit vessels may affect different companies differently. Typically, large changes in operating costs have a greater impact on smaller companies. The revenue profiles obtained were for larger companies, which may be more resilient to a changing regulatory environment. There are a number of smaller cruise companies for which no financial information was obtained; but again, with no actual revenue numbers or estimates of annual expenses or profit, it is not possible to provide any real perspective on the relative impact of retrofit and operational cost increases.

Conclusions

Commercial vessel operators will bear additional expenses to continue operating in Puget Sound, if it is designated as a NDZ. Direct retrofit costs would be a significant expense for tugboats, commercial fishing vessels, and small passenger vessels. In addition to the direct retrofit costs, there may be revenue losses resulting from disruption of operations because of the need to pump waste, or reduced revenue-generating capabilities of vessels following retrofit due to loss of space. Tugboats are likely the group most affected by lost working time resulting from the need to pump out because they typically spend the least amount of time at port. Fishing vessels and passenger vessels are more likely to experience revenue losses due to the reduction in revenue-generating space on the vessel (e.g., smaller fish holds or lower passenger capacity). An unknown number of small passenger vessels also face another significant potential cost because adding large holding tanks will produce a vessel classification change, which would result in substantially higher operational expenses.

The commercial maritime industry and the businesses that comprise that industry are highly varied in terms of size, revenue generation potential, and local and global presence. Tugboats, commercial fishing vessels, and small passenger vessels statewide generate over half a billion dollars in revenue, a significant portion of which is likely generated by vessels that operate on Puget Sound. However, there is limited publicly available financial information for these industries, so it is not possible to provide a

clear perspective of the impacts that NDZ regulations would have on individual businesses or industry groups.

The annual revenue estimates provided here represent a high-level overview of the relative cost to these industries of retrofitting vessels to meet NDZ regulations. Equipment costs (such as those related to retrofits), are viewed as long-term investments, and would need to be evaluated over the lifespan of the vessel. The indirect costs that would affect a vessel's per trip profitability need to be evaluated against normal operations costs for each vessel to understand more thoroughly and accurately the economic impact of instituting a NDZ in Puget Sound on the maritime industry. A more thorough evaluation would require access to more detailed private industry data.

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