Stantec

Memo

[i]To:	BC Ferries	From:	Tomasz Zolyniak….
File:		Date:	January 7, 2019

Reference: Wasterwater Consideration
Descanso Bay, Gabriola Island Ferry Terminal

OVERVIEW

BC Ferries (BCF) is developing a Terminal Development Plan (TDP) for the Gabriola Island Terminal. The intent is to develop a concept level plan for the upgrades to the terminal which are anticipated to include the construction of a new berth as well as improvements to parking, queuing lanes, and traffic flows. Passenger amenities such as a waiting room with washroom facilities are also included in the TDP. This plan will provide the framework for BCF to implement the upgrade strategies over the next 25 years.

The implementation of the TDP will require rezoning and updates to the Gabriola Island Official Community Plan (OCP). Stantec has been retained by BCF to aid with this process.

The memorandum will overview several options for wastewater disposal for the proposed terminal building.

EXISTING SANITARY SYSTEM

The existing sanitary system at the BC Ferries Gabriola terminal consists of a 1,000 US gallon (3785 liter) fibre-reinforced polymer tank that receives sanitary effluent from the terminal's washroom facility. The level of effluent in the tank is checked by a third party contractor daily and is generally pumped empty 2 – 3 times a week. The effluent in the storage tanks is not treated prior to pump-out. It is noted that effluent in storage tanks can produce gasses such as hydrogen sulfide, ammonia, methane, esters, carbon monoxide, sulfur dioxide and nitrogen oxides. Some of these gases have the potential to be explosive and others are considered health hazards with sufficient levels of exposure. Further review of the existing system should be conducted during detailed design to assess how these gases are being dealt with.

For the 2018 fiscal year, BC Ferries paid $25,000 + gst for weekly pump-out services.

The sewage holding tanks on the Quinsam vessel have a capacity of 18,727.

SANITARY SYSTEM OPTIONS

This memorandum will provide an overview of several effluent disposal options as follows.

- in-ground disposal
- marine discharge
- pumping for off-site disposal

For reference, the planned Island Class vessels that are to replace the Quinsam will have a sewage holding capacity of 27,100 liters, each.

Regulatory Requirements

The regulatory guidelines to be used as a basis for this project come from the British Columbia Environmental Management Act's Municipal Wastewater Regulations (MWR) and the federal Wastewater Systems Effluent Regulation (WSER). These regulations set the requirements for treatment plant effluent quality, depending upon on the nature of the discharge environment.

The BC MWR regulates minimum effluent quality and outfall design criteria based on the properties of the receiving environment and effluent flow rates.

The Federal WSER establishes minimum effluent criteria for all discharges with flows greater than 100 m3/day. There is no association to specific receiving environment conditions under the WSER.

In-ground and ocean outfall disposal options require a distinct effluent quality, and as such will have a bearing on the final treatment technology.

Municipal Effluent Classes

From Part 69, Environmental Management Act, Municipal Wastewater Regulation B.C. Reg. 87/2012 O.C. 230/2012, municipal effluent is classed as follows:

Class A, being high quality municipal effluent resulting from advanced treatment with the addition of disinfection and nitrogen reduction;

Class B, being high quality municipal effluent resulting from advanced treatment;

Class C, being municipal effluent resulting from secondary treatment;

Class D, being municipal effluent resulting from treatment in a septic tank.

The Maximum Day effluent flow rate is yet to be confirmed and provided by the project architect. The new terminal facility will include two washroom, each with a toilet and sink. Peak terminal usage occurs during the summer months, with an average of 1,000 patrons (foot passengers and vehicle passengers) per day. A Maximum Day effluent discharge rate of $10m^3$/day is assumed.

DISPOSAL SYSTEM CONSIDERATIONS

Several options exist for disposal of effluent from the project site. The three options that are discussed herein include in-ground disposal, marine discharge, and pumping for off-site disposal.

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IN-GROUND DISCHARGES

An in-ground system generally consists of a septic tank, treatment unit, distribution box, and drainage pipes in an absorption field.

Effluent Criteria for Ground Discharges

Part 76 of the *Municipal Wastewater Regulation* defines minimum unsaturated soil depth for ground discharge systems. Unsaturated soil means the soil between the land surface and the water table where the soil pore spaces contain water at less than atmospheric pressure, as well as air and other gases.

1. For class A or B municipal effluent, a discharger must ensure that the minimum unsaturated soil depth is 0.5 m.
2. For class C or D municipal effluent, a discharger must ensure that the minimum unsaturated soil depth for maximum daily flows of

   (a) less than 37 m^3/d is 0.75 m, and

   (b) 37 m^3/d or more is 1 m

Table 1 – Effluent Criteria: Ground Discharge

Requirement	Class A	Class B	Class C
BOD5 (mg/L)	10	10	45
TSS (mg/L)	10	10	45
Fecal coliform (MPN / 100 mL)	Average: 2.2 any sample: 14	400, if maximum daily flow is ≥ 37 m3/d	n/a
Turbidity (NTU)	Average: 2 any sample: 5	n/a	n/a
Nitrogen (mg/L)	Nitrate-N:10 total N: 20	n/a	n/a

The differentiation between Class A and Class B effluent relates to the proximity of the wastewater ground discharge to a drinking water source's zone of influence. If the discharge is within 300 meters of the drinking water source's zone of influent, the effluent must meet Class A requirements.

To meet the requirements of Part 76 of the MWR for ground discharge, the effluent requirement would be Class A.

Drainage pipe length requirements

Part 78 of the *Municipal Wastewater Regulation* defines minimum length of drainage pipes for the applicable municipal effluent class. The length set out for the applicable municipal effluent class and percolation rate is listed in Table 2.

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Table 2 – Minimum Drainage Pipe Length for Each Field

	Metres of drainage pipe for each 10 m3/d of maximum daily flow for percolation rates shown						
percolation rate (minutes/25 mm)	2	5	10	15	20	25	30
Class A, B or C municipal effluent	50	75	100	110	120	135	150
Class D municipal effluent	120	215	280	320	360	400	430

Geotechnical investigation will be required to determine the ground percolation rates. Upon determining the anticipated Maximum Day effluent flow rate, the length of drainage pipe can be interpolated depending on the percolation rate of the receiving ground. For a Maximum Day effluent flow rate of 10m3/day, the length of pipe can vary from 50m to 150m for Class A effluent.

Section 82(2) of the MWR specifies that:

a) drainage pipes are provided in 2 drain fields, each having at least the length of drainage pipe required under section78 *[drainage pipe length requirements]* unless a reduction is permitted under section 79 *[reductions in drainage pipe length]* ;

b) a third undeveloped drain field is retained as a standby area;

c) drain fields are constructed with trenches spaced

 (i) such that there is at least 3 m between the centre of each trench, or

 (ii) if the performance of the drain field would not be adversely affected, at least 2 m apart from each other with at least double the standby area;

Upon determining the anticipated Maximum Day effluent flow rate, the ground disposal area required for an in-ground disposal system depending on the percolation rate of the soil, can be determined. The current area of the BC Ferries terminal site is approximately 2200m^2, including building area. For three 50m drain fields, a ground disposal area of 300m^2 is required. For 150m drain fields, the area required would be 1200 m^2 (nine 50m trenches).

Setbacks

Part 82 of the *Municipal Wastewater Regulation* defines minimum setback requirements for the drainage system.

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Table 3 – Minimum Setback Distance

Row	Feature	maximum daily flow	
		< 37 m^3/d	≥ 37 m^3/d
1	property boundary	3	6
2	building drain, buffer strip	5	10
3	body of water	30	30
4	water within the Okanagan Basin	30	150
5	water well	60	90
6	water well within unconfined aquifer	60	300

Note: Setback values are shown in meters

Site Issues and Constraints

Although this is the most common wastewater discharge system utilized on Gabriola Island, site specific characteristics make this system difficult to implement at the ferry terminal location. The ferry site is relatively a small site and the setback requirements, particular those to a body of water and water wells, limit the location and size of the ground discharge system. Furthermore, inclusion of a ground discharge system would prevent BC Ferries from locating a water well on-site. Ground conditions, particularly soil percolation rates would determine the length of effluent discharge trenches, therefore a geotechnical investigation is crucial to determine the feasibility of this option.

Additional studies would also need to be completed to assess the feasibility of ground discharge at the site.

MARINE DISCHARGES

A marine discharge system generally consists of a wastewater treatment system that pumps the treated effluent into the marine environment.

Effluent Criteria for Marine Discharges

Any proposed wastewater treatment system and the associated marine outfall must be designed, constructed, and operated in compliance with both the BC *Municipal Wastewater Effluent Regulation (MWR)* and the federal *Wastewater Systems Effluent Regulation (WSE*R).

The *MWR* regulates minimum effluent quality and outfall design criteria based on the properties of the receiving environment and effluent flow rates

The WSER establishes minimum effluent criteria for all discharges with flows greater than 100 m^3/day. There is no association to specific receiving environment conditions under the WSER.

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The minimum effluent criteria for MWR and WSER are outlined in Table 3.

Table 4 – Effluent Criteria: Marine Discharge (Embayed Water)

MWR Criteria, max day flow <10m3/d		WSER	
Parameter	**Criteria**	**Parameter**	**Criteria**
Toxicity	Effluent is not acutely lethal[1]	Toxicity	Effluent is not acutely lethal[1]
BOD_5	n/a	$cBOD_5$	< 25 mg/L (average)
TSS	n/a	TSS	< 25 mg/L (average)
pH			
Ammonia Nitrogen	Based on receiving water characteristics[2]	Un-Ionized Ammonia (as Nitrogen)	1.25 mg/L (maximum at 15˚C ± 1˚C)
Fecal Coliforms	Based on receiving water usage[3]		
Total Residual Chlorine	<0.02 mg/L (maximum)	Total Residual Chlorine	<0.02 mg/L (average)

1. Effluent standards for ammonia nitrogen are based on the predicted dilution within the effluent plume at the boundary of the Initial Dilution Zone (IDZ). The IDZ is defined in the MWR as a cylindrical volume of water centered on the terminus of the outfall with a radius that is the lesser of 100 m or 25% of the width of the body of water; the cylinder extends from the seafloor to the surface of the water.
2. The allowable ammonia nitrogen concentration is based on back calculations of water quality guidelines and the predicted dilution of the effluent plume at the boundary of the IDZ. The most stringent water quality guideline, for the proposed discharge, is the average 5 to 30 day concentration of total ammonia nitrogen for the protection of marine life (MOE 2001). The applicable guideline is based on a pH of 8.4 (MOE 2001), a minimum salinity of 20 g/kg, and a maximum temperature of 15°C. In this case, the most stringent water quality guideline for ammonia nitrogen at the edge of the IDZ is 0.59 mg/L.
3. The allowable effluent fecal coliform concentration is back calculated from the predicted dilution at the boundary of the IDZ and any sensitive areas, and is based on the allowable fecal coliform concentration for these areas. The allowable fecal coliform concentration is dependent on the water based activities in the area of the discharge.

   For discharges to recreational use waters, the applicable water quality standard states that the number of fecal coliform organisms outside the IDZ must be less than 200 MPN /100 mL. Recreational usage is considered as any activity involving the intentional immersion (e.g., swimming) or incidental immersion (e.g., waterskiing) of the body, including the head, in natural waters" (Health and Welfare Canada 1992).

   For discharges to shellfish bearing waters the applicable water quality standard is median or geometric mean of less than 14 MPN/100 mL at the edge of the IDZ (Canadian Food Inspection Agency 2008). For the purpose of this regulation, shellfish water means water bodies that "have or could have sufficient shellfish quantities that recreational or commercial harvesting would take place or water for which commercial shellfish leases have been issued" (WLAP 1999). Shellfish are defined as: "all edible species of oysters, clams, mussels and scallops either shucked, in the shell, fresh or fresh frozen or whole or in part. For the purposes of marine biotoxin control, predatory gastropod molluscs shall also be included" (Canadian Food Inspection Agency2008).

Per MWR, for discharges to marine waters having a maximum daily flow of less than 10 m3/d, a discharger must use a septic tank that meets the design requirements set out in section 39 [septic tanks].

TREATMENT SYSTEM CONSIDERATIONS

For isolated sites, connections to municipal wastewater treatment plants is not feasible or practical. There are cost-effective small-scale sewage treatment plants that do exist for lower capacity areas such as the BC Ferry site. Evaluation of treatment options will consider a modular, turnkey construction system. The newest generation of small-scale community sewage treatment plants combine, multi-stage treatment systems and units such as:

- Sequencing-Batch-Reactor (SBR) Processing
- Membrane Reactor using Ultrafiltration
- Continuous-Batch-Reactor (CBR) Processing
- Short-Time-Batch-Reactor (STBR) Processing
- Biofilm Method using growth bodies from plastic
- Vented Biofilters for wastewater treatment
- Fixed-bed plants for wastewater treatment
- Plant based purification systems (etc.)

Small-scale sewage systems are customized and pre-assembled for ease of installation. Designed as a prefabricated system, the wastewater treatment plant can be designed to the needs of the BC Ferry terminal building and meet local water quality standards. Adding to the Primary treatment via mechanical pre-cleaning and secondary treatment using a biological process along with other treatments, a tertiary treatment process can be integrated as well. Tertiary treatment will not be considered at this time.

A typical 10m^3/day package plant would have a small footprint of about 3 m x 6m with the associated blowers, controls , pumps UV disinfection etc. installed inside a small garage sized building which can be made architecturally attractive and screened behind landscaping. The processes are aerobic and the process equipment will be covered so odour generation will not be a problem, However, the design would consider evacuating the air space in some of the covered tankage with discharge through a carbon-filter.

Biosolids

All of the package plant systems will generate biosolids as the process for removing organic material is to aerobically convert the organic material into cellular material and then separate this solid material from the liquid phase of the wastewater. Approximately 95% of the organics in the raw wastewater or xx.x kg/day will be removed by the treatment process. In the process of removal, organics will be converted to approximately x.x kg/day of bio-solids which will be contained in about x.x m3/day of waste sludge. Following aerobic digestion, the biosolids will be reduced to about x.x kg /day of digested sludge which would be wasted at a concentration of 3% solids with a volume of approximately x.x m3/day. This waste sludge would be stored in an aerobic digester and then pumped to a sludge haulage vehicle once per month. The average monthly volume of sludge for disposal at a septage disposal site will be x.x m3.

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Site Issues and Constraints

For a very small facility, such as the proposed one at the BC Ferries Gabriola terminal site, marine discharge is generally cost and time prohibitive. Several approvals, permits, and authorizations that would be required for this option are identified below.

- Navigation Protection Act – Transport Canada: The Navigation Protection Act (NPA) prohibits the construction of certain projects on marine and navigable freshwater without federal approval. Projects that affect navigable waters may require approval under the NPA.
- Request for Review – Fisheries and Oceans Canada: Proponents are required to conduct a 'Self-Assessment' to determine if a Fisheries and Oceans Canada (DFO) 'Request for Review' is required for projects near water (i.e., freshwater and marine environments with some connectivity to fish). The 'Self-Assessment' involves using criteria (e.g., types of waterbodies and project activities) developed by DFO to determine if the project requires a 'Request for Review'. A 'Request for Review' is conducted to determine if a project can be completed without causing 'serious harm to fish' as defined under the Fisheries Act (Section 35(2)). If DFO determines that 'serious harm to fish' could result from a project and cannot be avoided or mitigated, a Fisheries Act Authorization (Section 35(2)(b))will be required before work can commence. When 'serious harm to fish' cannot be avoided or mitigated, offsetting measures (i.e., compensation) will be required.
- Work in and around a Stream – Ministry of Forest, Land, and Natural Resource Operations: [Likely not applicable].
- Municipal Wastewater Regulation Registration – Ministry of the Environment: BC Ferries will likely need to conduct an EIS, however the scope of the EIS is determined at the pre-registration meeting. An EIS is required under the MWR in order to apply for a discharge permit. The Stage 1 EIS identifies physical and socio-economic features, property encumbrance and water system issues, hydrogeological and geotechnical limitations, and includes dilution modelling at the outfall. A Stage 2 EIS includes the information in a Stage 1 as well as site specific information which typically involves field studies, such as pre-discharge water quality monitoring, habitat studies, archaeological studies, current studies, bathymetric study, and plume modelling. Preparing registration documents, operating plans, EIS documents and field studies can take approximately one year. The preparation time depends on the type of studies the MOE requires as they may request multiyear studies (e.g., water quality). After the registration document has been submitted to the Province it is put in a queue. Our last update from the Province indicated that it is takes approximately 1 to 1.5 years to conduct a review of the project information. Typical costs for completing the registration process range from $75,000 to $200,000.
- Archaeological Impact Assessment
- Geotechnical Investigation.

HOLDING TANK AND PUMP-OUT

This type of sanitary system would consist of a sanitary storage tank complete with aeration and pump-out mechanism. The tank would need to be regularly pumped-out for off-site treatment and disposal of the effluent. The effluent in the holding tank could be either pumped into a pumper truck or directly into the BC Ferry vessel.

Effluent Criteria for Pump-Out

Temporary storage of effluent would need to meet minimum MWR requirements for septic tanks. Section 39 [septic tanks] identifies the following requirements.

> 39 (1) In designing a wastewater facility using a septic tank, a qualified professional must ensure that all of the following requirements are met:
>
> (a) the tank has a hydraulic capacity of at least 2 days' minimum detention time at the design maximum daily flow;
>
> (b) the tank is fitted with an effluent filter, a screen or an equivalent measure to protect pumps and prevent discharge of solids and floatables;
>
> (c) the tank is accessible for pump out.

The maximum daily flow needs to be provided by the project architect to confirm the storage tank volume. For the purpose of comparison, assuming Maximum Day effluent flow rate of $10m^3$/day, the tank volume would need to be 20,000 liters.

To prevent the effluent from going septic, it is proposed that the storage tank include an aeration system at the base of the tank. The introduction of air into the effluent would reduce the wastewater anaerobic conditions and mitigate production of hydrogen sulfide gas (creating the "rotten egg" odor associated with septic wastewater). Tanks would also be fitted with carbon filters on exhaust vents to further control the discharge of potential odours.

Similar to the existing condition, the effluent in the storage tank would need to be routinely pumped out and disposed of off-site. Two options exist for the pump-out scenario.

1. Sewage could be pumped directly from the site storage tank and into the BC Ferry vessel. The BC Ferry vessel would sail back Nanaimo Harbour where the vessels holding tanks are emptied into the municipal sanitary system.
2. A pumper truck would pump out the effluent from the site storage tank into its storage tank. The tanker would sail on the BC ferry vessel and once on the Nanaimo side, connect to the municipal wastewater system for discharge and disposal.

Site Issues and Constraints

In General, this option would continue sewage disposal at the project site as usual. Siting the tank location would require additional geotechnical and archaeological investigations. The tank size is significant for the available lot size, a cylindrical tank with a diameter of 3m and a length of 3m would yield a size of

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approximately 21m^3. The tank would be horizontally oriented and possible located underneath the new terminal parking lot.

Odour management from the holding tank would be managed by use and maintenance of the aeration system, further doour control could be achieved by utilizing activated carbon filters on the holding tanks exhaust vent.

Effluent treatment is not included with this option, rather it involves storage of raw effluent and direct pump-out for discharge

CONCLUSION

Three sanitary disposal options have been reviewed in this memorandum. The remote nature as well as the limited land availability of the subject site provides challenges for sanitary treatment.

The marine outfall option is least feasible due to numerous regulatory requirements as well as the time commitment necessary to secure approvals, permits, and authorizations. The system would also be the most expensive of those reviewed due to the combination of required pre-construction costs (approvals, permits, and authorizations) and construction costs (treatment unit, marine outfall, etc).

The in-ground disposal option has some merit for the site but would require further detailed analysis. The subject site is small for the requirement of the pipe field lengths. The presence of other services including existing water wells, proposed water well option, and stormwater infrastructure add additional difficulties for implementation of the in-ground system.

The holding tank and pump-out option is the most feasible solution for effluent management at the BC Ferries site. This would be the most compact solution to sanitary management and would require regular pump-out of the tanks effluent for off-site treatment and disposal.

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Attachment:

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References:

1. [i]Stantec. “Bowser WWTP – Effluent Disposal Options Analysis (Outfall vs. Ground)” Technical Memorandum, Stantec Consulting Ltd., 2016.