Comox Valley REGIONAL DISTRICT

Staff report

DATE: November 08, 2016

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TO: Chair and members
Comox Valley sewage commission

FROM: Debra Oakman, CPA, CMA
Chief Administrative Officer

RE: Comox Valley water pollution control center capacity and effluent quality upgrades

Purpose
To present the findings and recommendations from the Comox Valley water pollution control center (CVWPCC) capacity assessment and ultraviolet (UV) disinfection feasibility study.

Policy analysis
The Comox Valley Regional District (CVRD) operates a sewerage service primarily for the City of Courtenay and Town of Comox, established by Bylaw No. 2541, being the "Comox Valley Sewerage Service Establishment Bylaw No. 2541, 2003".

The 2016 to 2020 Comox Valley sewerage service financial plan includes funding for a "system capacity analysis" and "UV disinfection study" for the CVWPCC.

Executive summary
The 2011 CVRD sanitary sewerage master plan and long term financial plan (2014) both identify the need for capital upgrades to the CVWPCC. The original facility was commissioned in 1984 and has undergone expansions in 1993 and 2008. As population and flows increase, upgrades are required to meet existing system demands and provide capacity increases to accommodate growth. Upgrades to alleviate capacity concerns will trigger the requirement for the CVWPCC to become registered under the *Municipal Wastewater Regulations* (MWR). These more stringent regulations require additional upgrades to improve effluent quality in order to be in compliance with the MWR.

In order to better understand the capital upgrades and operational requirements required to service a growing population and changing regulations, a capacity assessment of the treatment plant and outfall was conducted along with an UV disinfection feasibility study. The CVWPCC capacity assessment, completed by ISL Engineering and Land Services (ISL) and attached as appendix A, provides information on the treatment plant's current capacity and develops options to increase capacity and improve effluent quality. The UV disinfection feasibility study, completed by AECOM and attached as appendix B, investigates the application and performance of UV disinfection with options and cost estimates for the installation of UV equipment.

To determine the required upgrades to increase capacity at the CVWPCC, ISL modelled the treatment plant and identified upgrades or improvements that are required based on projected flows and loads. From this work ISL developed a phased upgrade that is designed to provide plant capacity to 2066. The first phase of upgrades are required to alleviate current plant capacity constraints, as well as ensuring MWR redundancy and effluent quality requirements are achieved. The preferred option includes the addition of an equalization tank after the primary clarifiers to reduce peak hour flows and a cloth media filter, both upgrades will help to ensure adequate capacity and effluent quality during periods of high flow. Subsequent upgrades are required based upon future flows and loading.

In addition to capacity constraints both ISL and AECOM identified that upgrades are required to improve effluent quality to satisfy MWR requirements. The CVWPCC currently operates under discharge permit PE-5856 that was issued at the time of construction of the plant in the 1980's. The CVWPCC regularly exceeds the existing permit discharge requirements and it has been identified that any upgrades at the plant will trigger the need to register under the MWR and to comply with the more stringent regulations as laid out within the MWR.

In order to comply with the effluent quality guidelines as specified within the MWR, wastewater effluent must be disinfected prior to discharge. There are two primary options for disinfection of wastewater; chlorine or UV light. Environment Canada and the Department of Fisheries and Oceans Canada (DFO) have been encouraging the use of non-chlorine based disinfection because of the reduced environmental impacts that UV disinfection provides. Additionally UV disinfection has operational benefits of minimal health and safety issues, low maintenance requirements and the lack of residuals created in the process. The UV feasibility study as completed by AECOM, identified a disinfection target for fecal coliforms at the end of the pipe and provided preliminary cost estimates.

To improve UV performance, reduce operating costs, delay installation of additional tankage and minimize reactor sizing costs, ISL recommended the installation of a cloth media filter prior to the UV reactors. The construction of a cloth media filter will ensure superior effluent quality and optimize the success and performance of any UV disinfection technology that may be added to the treatment process, along with providing an opportunity for water reuse in the future. Although a cloth media filter has higher capital costs than chemical treatment, chemical use is minimized therefore significantly reducing operations and maintenance costs, resulting in a cloth media filter being a more cost effective option over the long term.

Significant capital expenditures are required to alleviate plant capacity constraints and satisfy effluent quality requirements under the MWR. Table no. 1 below highlights the costs and approximate year of need for various treatment plant upgrades.

Table No.1: CVWPCC recommended upgrades

Phase	Year of Need	Project Description	Requirement	Cost
1	2017	Repair existing offshore pipe	Capacity/Environmental	$168,000
		Mechanical screen/grit removal	Capacity	$2,067,800
		Construct offline equalization tank	Capacity	$5,847,800
		Install UV Disinfection (MWR compliance)	Effluent Quality	$3,115,000
		Add cloth media filter	Effluent Quality	$7,404,600
		Reclaimed water service	Capacity	$375,000
			Total Phase 1 Costs	**$18,978,200**
2	2024	Construct one aeration tank & clarifier	Capacity	$6,610,000
			Total Phase 2 Costs	**$6,610,000**
3 (Begins 2031)	2031	Replace outfall	Capacity	$19,528,600
	2033	Construct two primary clarifiers and a new process building	Capacity	$10,711,400
			Total Phase 3 Costs	**$30,240,00**
			Total Capital Project Costs (to 2033)	**$55,828,200**

The upgrades as detailed above, provide added maintenance advantages and fail safes to plant operations that do not exist in the current configuration. Additional upgrades will be required past the year 2033 to provide capacity to 2066. As compared to the current long term financial plan phase one and two costs are less than what was previously budgeted, however the bulk of these expenditures is occurring earlier.

An offline equalization tank at the beginning of the process will help provide a constant flow rate throughout the plant mitigating high flows during peak wet weather events and providing improved process control. Cloth media filters and UV disinfection equipment will ensure effluent regulations are met year round even during peak wet weather events. The recommended option also allows the current effluent pumping system to be utilized to the end of its design life resulting in the previously approved effluent pumping upgrades no longer being required and avoiding pressurizing of the outfall.

Recommendations from the chief administrative officer:

1. THAT the Comox Valley Regional District proceed with planning, engineering and construction of phase one of the Comox Valley water pollution control center (CVWPCC) upgrade option 3 identified within the CVWPCC Capacity Assessment completed by ISL Engineering and Land Services dated August 2016;

   AND FINALLY THAT as part of the phase one upgrades for the CVWPCC, ultraviolet disinfection technology with a disinfection target of 200MPN/100mL be included within the scope of work for the detailed design.

2. THAT the following motion approved at the May 17, 2016 Comox Valley sewage commission be repealed:
   THAT the Comox Valley Regional District proceed with planning, engineering and budget amendments as required to upgrade outfall effluent pumping as per option 1 of the staff report dated May 10, 2016.

Respectfully:

D. Oakman

Debra Oakman, CPA, CMA
Chief Administrative Officer

Background/current situation

The CVWPCC was commissioned in 1984 and has undergone expansions in 1993 and 2008. Effluent from the plant is discharged to the marine environment of Georgia Strait via an outfall pipe extending east from Cape Lazo. As population and flows increase, upgrades are required to meet existing system demands and provide capacity increases to accommodate growth. Upgrades to alleviate capacity concerns will trigger the requirement for the CVWPCC to become registered under the MWR. These more stringent regulations require additional upgrades to improve effluent quality in order to be in compliance with the MWR. The sections below describe both the capacity and effluent quality driven upgrades.

Capacity Upgrades

In order to better understand the capital upgrades and operational requirements of the plant today and what is required to service a growing population, a capacity assessment of the treatment plant and outfall was conducted. A request for proposal for a treatment and outfall capacity study closed on February 12, 2016 and a contract was awarded in early March 2016 to ISL. The study was completed in two distinct parts, the first part being the Cape Lazo outfall capacity assessment which was completed in April 2016 and the second part being the CVWPCC capacity assessment.

The CVWPCC capacity assessment provides information on the treatment plant's current capacity and develops options to increase capacity for the future. Modelling of the current treatment process performed by ISL indicates the ultimate service capacity of each unit process and identifies upgrades or improvements that are required based on projected flows and loading. The assessment also reviewed regulatory requirements and any permits and approvals that may be required. It was identified within the study that any upgrades at the plant will trigger the need to register under the MWR and to comply with all regulations as laid out within the MWR, including disinfection of wastewater effluent. As such, ISL considered effluent quality requirements within their analysis, these are discussed below in the effluent quality upgrades section.

A total of seven upgrade options were developed by ISL and upon further review two options were carried forward and an additional hybrid option was created. Each of the three options are designed to provide phased plant capacity to 2066 and meet the effluent quality and redundancy requirements under the municipal wastewater regulation. Each option involves intermediate stages to phase in additional capacity to accommodate projected population growth.

All options require the following upgrades in the year 2017:

- Replace the existing 12mm mechanical screen with a 6mm screen
- Add a grit removal tank with cyclones and classifier units
- Decommission the existing primary sludge cyclones and classifiers and send the primary sludge directly to the sludge thickeners
- Repair existing offshore pipe as identified in the April 2016 Cape Lazo outfall capacity assessment

Separate from the upgrades noted above, each option requires additional phased upgrades to alleviate current plant capacity constraints and provide for near term projected population growth. The additional upgrade options are as follows:

Option 1:

- Phase 1 (2017):
  - Inject soda ash for pH adjustment and to boost alkalinity
  - Inject polymer prior to clarifiers (provision to be confirmed by jar testing)
  - Construct an offline equalization tank

- Construct one aeration tank and clarifier

Option 2:

- Phase 1 (2017):
  - Add a cloth media filter
  - Inject polymer prior to cloth media filters (provision to be confirmed by jar testing)
  - Upgrade effluent pumps as identified in April 2016 Cape Lazo outfall capacity assessment
- Phase 2 (2024):
  - Construct one aeration tank and secondary clarifier

Option 3:

- Phase 1 (2017):
  - Construct an offline equalization tank
  - Add a cloth media filter
  - Inject polymer prior to cloth media filters (provision to be confirmed by jar testing)
- Phase 2 (2024):
  - Construct one aeration tank and secondary clarifier

A third phase of upgrades will be required under all options to reach the ultimate build out to 2066, however these upgrades are not expected to begin until 2031. Given that the total capital costs and estimated yearly operation costs vary between the options, ISL conducted a net present value (NPV) analysis over a 50 year period. The NPV analysis below excludes odour control upgrades and UV disinfection technology. The NPV is a formula that is commonly used to compare project options by determining the present value of each option over a specified time period. This is done by calculating the discounted sum of all cash flows, including capital and operating costs, which are to be part of each option and then comparing the resulting NPV's. Table no. 3 below compares the capital, operating and NPV analysis for each option.

Table No. 2: Capital, operating and NPV analysis of upgrade options

Description	Option 1	Option 2	Option 3
Total capital costs	$61,183,000	$63,346,000	$69,082,000
Estimated yearly operating costs	$488,000	$60,000	$68,000
NPV	**$59,533,000**	**$48,693,300**	**$53,637,000**

From the net present value analysis options 2 and 3 are favoured, primarily due to high chemical costs associated with chemical injection that are required in option 1. Due to operational challenges and costs associated with option 1, this option was not considered further. In determining the most appropriate option between options 2 and 3 the following factors were considered:

- Utilization of the existing infrastructure to its full potential wherever possible
- Upgrades that improve the treatment process but also improve current maintainability
- Capital and long term operating costs of the upgrades
- Reduced risk associated with pressurizing the outfall

The annual operating costs for both option 2 and 3 are comparable and the difference is negligible. However, the difference in capital costs over 50 years is approximately $5.5 million for option 3. Benefits of option 3 include utilizing the existing outfall effluent pumps to their full design life and not requiring a condition assessment of the outfall. Option 2 would require a condition assessment of the pipe to determine if pressurizing the outfall is feasible, this assessment is estimated at approximately $300,000 with the potential for upgrades based on the findings. Option 3 negates the need to replace the existing effluent pumps as previously approved by the sewage commission along

with not requiring an increase to the operating pressure of the existing outfall, essentially reducing the risk to the discharge system.

Additional benefits and risk mitigation that are provided as part of option 3 include:

- Protecting the treatment plant from hydraulic shock loads
- The ability to take offline, isolate and/or bypass sections for maintenance (not available in the current configuration)
- Improving process control
- Adding a bypass option during construction and emergency situations
- Avoiding the need to pressurize the existing outfall (reduced risk)
- Extending the use of the existing effluent pumping system

As recognized by ISL, both options 2 and 3 provide favorable solutions that complement existing plant operations. However option 3 provides added maintenance advantages and fail safes to plant operations that do not exist in its current configuration or that are provided within option 2.

In addition to providing improved capacity, option 3 also provides for the construction of a cloth media filter for improved effluent quality as described below.

Effluent Quality Upgrades

The CVWPCC operates under discharge permit PE-5856 that was issued at the time of construction of the plant in the 1980's, the permit does not specify requirements for disinfection and currently the CVWPCC does not utilize a disinfection process prior to discharge. However, the MWR requires disinfection of treated effluent prior to discharge. Although the CVWPCC is not currently regulated under the MWR, changes to regulations and upgrades at the treatment plant will require the CVWPCC to register under the MWR.

As part of the environmental impact study that was completed by Worley Parsons in 2011 it was determined that the fecal coliform count at the end of the pipe should be no greater than 8000MPN/100mL to achieve MWR requirements for shellfish bearing waters at the edge of the initial dilution zone. Typical UV systems are designed to achieve less than 200MPN/100mL at the end of the pipe, providing additional redundancy and ensuring the plant will consistently meet effluent requirements. Standard reactor sizing within the industry is either 14 or 200MPN/100mL, however with both disinfection targets provisions are included for operations staff to modulate the lamp output and lower the disinfection target if desired to save energy costs. Additionally MWR requirements for reclaimed water requires a UV disinfection target of 200MPN/100mL for effluent reuse at the CVWPCC.

In combination with the installation of UV disinfection technology, the construction of a cloth media filter will optimize the success and performance of any UV disinfection technology, reduce operating costs, delay installation of additional tankage and minimize reactor sizing costs, along with providing an opportunity for water reuse in the future. Although a cloth media filter has higher capital costs than chemical treatment, chemical use is minimized therefore significantly reducing operations and maintenance costs and resulting in a cloth media filter being a more cost effective option in the long term. By constructing the UV and cloth media filter at the same time an additional anticipated cost savings of $300,000 is expected.

The use of non-based chlorine disinfection is encouraged by both Environment Canada and the DFO because of the reduced environmental impacts that UV disinfection provides. UV disinfection has the operational benefits of minimal health and safety issues, low maintenance requirements and

the lack of residuals created in the process. The addition of a cloth media filter and UV disinfection will provide built in redundancy and will ensure that the CVWPCC is minimizing operations costs whilst meeting MWR regulations over a variety of flows and loads.

Parts of the treatment process at the CVWPCC are already at or are nearing capacity. Phase one of the CVWPCC upgrades identify and assess current capacity constraints. Additional phases of upgrades have been identified to provide for future population growth and will only occur when flows and loads are experienced that correlate to the next phase of upgrades. Effluent quality upgrades are required for compliance with the MWR and are necessary as the capacity driven upgrades will trigger the need for the CVWPCC to register with the MWR.

Options

The commission has the following options to consider:

1. Proceed with recommended upgrades to the CVWPCC as per option 3 as outlined within ISL's CVWPCC capacity assessment report dated August 2016 and include UV disinfection as recommended within AECOM's UV feasibility study dated September 2016.
2. Proceed with recommended upgrades to the CVWPCC as per option 2 as outlined within ISL's CVWPCC capacity assessment report dated August 2016 and include UV disinfection as recommended within AECOM's UV feasibility study dated September 2016.
3. To not proceed with upgrades to the CVWPCC at this time.

ISL's recommended option 3 provides additional maintenance advantages and fail safes to plant operations. The installation of a cloth media filter will provide superior effluent quality, ensure optimal success and performance of any UV disinfection that may be added to the treatment process, reduce operations costs, delay additional tankage requirements and minimize initial UV reactor sizing. An offline equalization tank at the beginning of the process will help provide a constant flow rate throughout the plant, mitigating high flows during peak wet weather events and providing improved process control. In addition option 3 allows the current effluent pumping system to be utilized to the end of its design life without any upgrades or increasing the pressure within the outfall. Due to the improved operations and maintenance provide within ISL's option 3, only option no.1 above is recommended.

Financial factors

Operations and maintenance costs for the proposed upgrades are estimated at $116,200 per year and include labour, power and chemical requirements for operations.

The existing long term financial plan (2014-2029), identified two phases of major treatment upgrades in addition to adding a new primary clarifier. The table below compares the cost projections from the long term financial plan to estimated capital costs for the treatment plant to the year 2029, not included within the table are capital costs associated with upgrades to the odour control system.

Table No. 3: Capital costs comparison

Description	Long Term Financial Plan		Option 1		Option 2		Option 3	
	Year	Cost	Year	Cost	Year	Cost	Year	Cost
Phase 1 upgrades	2018	$6,500,000	2017	$16,427,000	2017	$12,021,000	2017	$15,489,000
UV Disinfection	-	--	2017	$3,115,000	2017	$3,115,000	2017	$3,115,000
Primary clarifier	2021	$2,507,700	--	---	--	---	--	---
Phase 2 upgrades	2024	$24,000,000	--	---	2024	$6,610,000	2024	$6,610,000
Total capital costs		**$33,007,700**		**$19,542,000**		**$21,746,000**		**$25,214,000**

Compared to the existing long term financial plan, capital costs to 2024 are lower, however the timing of these expenditures is sooner than what was projected within the long term financial plan. Funding for phase one upgrades would be a combination of borrowing and transfer from reserves. Reserve funds will be drawn to minimum levels over the coming years to help fund capital projects. Although significant spending for capital projects is expected over the coming years, the current proposed municipal requisition and reserve funds are sufficient and should not require further increases over and above the current approved amounts.

Legal factors
Upgrades to the CVWPCC will require registration under the MWR. All identified improvements to the CVWPCC will ensure that the plant is compliant under the more stringent MWR requirements.

Regional growth strategy implications
Upgrades to the CVWPCC will help ensure proper and effective treatment of wastewater for future generations whilst supporting a high quality of life through the protection and enhancement of community health and safety.

Disinfection of the effluent will add improved redundancy within the treatment process, compliance with regulations and increase local shellfish harvesting security by ensuring fecal coliform limits at the end of pipe are below guidelines.

Intergovernmental factors
The Comox Valley sewerage service is governed by the sewage commission whose membership includes representation from the Town of Comox, the City of Courtenay and the Department on National Defence.

Interdepartmental involvement
The engineering services branch is leading this work.

Citizen/public relations
The CVWPCC is requiring significant upgrades in order to increase capacity and accommodate growth. An increase to the municipal requisition will ultimately affect the residential tax rate within the City of Courtenay and the Town of Comox.

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Attachments: Appendix A – "CVWPCC Capacity Assessment, ISL Engineering and Land Services"
Appendix B – "UV Disinfection Feasibility Study, AECOM"