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Rise and Report (Items Released from Closed Meeting)

On June 28, 2019, the attached report was authorized by the Greater Vancouver Sewerage and Drainage District (GVS&DD) Board of Directors to be released to the public:

Tertiary Treatment Options at GVS&DD Treatment Plants

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Date: June 28, 2019

Subject: **Tertiary Treatment Options at GVS&DD Treatment Plants**

PURPOSE
To respond to the Board's request for staff to report back with information on tertiary treatment options for the North Shore Wastewater Treatment Plant and the Iona Island Wastewater Treatment Plant and to respond to questions from the Board on tertiary treatment in general.

BACKGROUND
At the March 29, 2019 GVS&DD Board meeting, the Board received the report titled "North Shore Wastewater Treatment Plant Indicative Design" and adopted the following motion:

> *That the GVS&DD Board:*
> *a) receive for information the report dated March 7, 2019, titled "North Shore Wastewater Treatment Plant Indicative Design"; and*
> *b) direct staff to report back with information on tertiary treatment options for North Shore Wastewater Treatment Plant and Iona Island Wastewater Treatment Plant including costs and funding sources.*

This report responds to the Board's request for information on tertiary treatment options for the North Shore and Iona Wastewater Treatment Plants. In response to a request made at the May 24, 2019 Board meeting, this report also provides additional information regarding the considerations for moving towards tertiary treatment for all five GVS&DD wastewater treatment plants.

THE CANADA-WIDE STRATEGY FOR THE MANAGEMENT OF MUNICIPAL WASTEWATER EFFLUENT
In the 2000's, through the Canadian Council of Ministers of the Environment, the provincial and territorial Environment Ministers and their federal counterpart worked to develop a comprehensive, long-term national strategy for municipal wastewater effluent. On February 17, 2009 they adopted *The Canada-wide Strategy for the Management of Municipal Wastewater Effluent,* which defines a base level of secondary treatment for Canada and a science-based risk assessment process to identify if tertiary or higher levels of treatment are needed for a specific discharge location.

In 2011 the BC Minister of Environment approved Metro Vancouver's *Integrated Liquid Waste and Resource Management Plan*, which aligns the provincial requirements with the Canada-wide strategy. The provinces and territories have aligned their wastewater regulations with the strategy and the federal government in 2012 proclaimed the *Wastewater Systems Effluent Regulations* under the *Federal Fisheries Act*. As both a provincial and federal requirement, the North Shore Wastewater Treatment Plant and the Iona Island Wastewater Treatment Plant are required to meet the secondary treatment standard by December 31, 2020 and December 31, 2030 respectively.

The Canada-wide strategy is in keeping with similar approaches for the management of municipal wastewater effluent adopted by the United States and the European Union. This includes the base requirement for at least secondary treatment and a science-based approach to establish the need for

higher levels of treatment. Key to the science-based approach is the determination by the regulators of receiving water Environmental Quality Objectives (EQOs) to ensure the protection of the receiving waterways for designated uses and aquatic life. Wastewater treatment plants must meet Environmental Discharge Objectives (EDOs) to ensure that the EQOs are met and the waterways protected.

THE LWMP AND THE ENVIRONMENTAL MONITORING COMMITTEE

Metro Vancouver's Liquid Waste Management Plan (LWMP) was originally approved by the BC Minister of Environment in 2002. The LWMP established an Environmental Monitoring Committee that is responsible for reviewing the scope and design of environmental monitoring programs, reviewing the monitoring program results, and reviewing the predictive modelling and risk assessments of waste discharges. The Environmental Monitoring Committee continues to be actively involved in the programs undertaken annually by the Liquid Waste Services Department's Environmental Management and Quality Control Program. Current committee membership includes Metro Vancouver, City of North Vancouver (representing the North Shore Sewerage Area), Vancouver (representing the Vancouver Sewerage Area), Surrey (representing the Fraser Sewerage Area), BC Ministry of Environment and Climate Change Strategy, BC Ministry of Agriculture, Vancouver Health Authority, Environment and Climate Change Canada, Fisheries and Oceans Canada (currently vacant), Port of Vancouver, University of British Columbia, Simon Fraser University and a public member (currently vacant).

Metro Vancouver's Environmental Management and Quality Control Division has investigated receiving water conditions surrounding Metro Vancouver's discharge points in relation to the water column, sediment and aquatic biota. As well, ambient waters are monitored in the region where no Metro Vancouver discharge points exist to establish environmental base lines. The program includes annual beach monitoring in the summer months and investigations related to stormwater in the region. Comprehensive monitoring of wastewater influent and effluent at the treatments plants has been undertaken for a broad range of chemical constituents.

The numerous environmental investigations undertaken as part of the Environmental Management and Quality Control Program are documented annually in the *Greater Vancouver Sewerage and Drainage District Environmental Management and Quality Control Annual Report* (see Reference 1 for the most recent report) and biennially in the *LWMP Biennial Report* (see Reference 2 for the most recent report). Investigations have confirmed that water quality objectives are generally being met in the region's receiving environment.

LEVELS OF TREATMENT AND EFFLUENT QUALITY

Modern wastewater treatment can be considered a continuum that ranges from primary treatment to advanced treatment processes that result in reclaimed drinking water. Table 1 below presents the range of treatment processes available to treat wastewater at a primary, secondary and tertiary level.

Table 1. Wastewater Treatment Progression

Stage	Removal Target
Primary Treatment (BOD and TSS removal) Secondary Treatment (BOD and TSS removal) Tertiary Filtration (BOD and TSS removal) Biological Nutrient Removal (Tertiary Treatment)	Settleable and floatable material Dissolved organic material Fine, suspended material Nitrogen and Phosphorus
Disinfection	Bacteria, viruses and other microbes
Advanced Treatment - Micro filtration - Ultra filtration - Reverse osmosis - Oxidation - Adsorption	Further removal of substances to produce potable reclaimed water (for indirect or direct reuse)

The strength of wastewater is measured by two key indicators – Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS). Typical regulatory requirements related to primary, secondary and tertiary effluent standards are:

Primary Treatment: 130 mg/L BOD, 130 mg/L TSS
Secondary Treatment: 25 mg/L BOD, 25 mg/L TSS
Tertiary Treatment: <10 mg/L BOD, <10 mg/L TSS

Tertiary treatment is most often associated with two main parameters – the removal of nutrients (nitrogen and phosphorus) to prevent algae blooms in the receiving environment, and filtration to remove fine particulate matter that results in lower TSS values. Tertiary treatment, whether nutrient removal or filtration, polishes the effluent to a higher standard, which generally allows the effluent to be utilized for reclaimed non-potable water applications, such as irrigation or street cleaning, effectively avoiding the use of drinking water for these applications. Further advanced treatment steps are necessary to bring tertiary effluent to a potable water standard.

Table 2 below compares the levels of treatment at the existing GVS&DD Annacis and Lulu Island secondary treatment plants to the new North Shore WWTP and Northwest Langley WWTP, along with the new Capital Regional District WWTP located in Victoria.

Table 2. Comparison of Annacis/Lulu, North Shore, Northwest Langley and the CRD plants

	Annacis/Lulu (existing)	North Shore (new)	NW Langley (upgrade)	Capital Regional District (new)
Secondary Treatment	✓	✓	✓	✓
Wet Weather Treatment (primary and/or other)	✓	✓	✓	✓
Tertiary Filtration		25%	✓	✓

Nitrogen Removal • Installed			✓	
• Migration path		✓		
Phosphorus Removal • Migration path		✓	✓	
Disinfection • Chlorine (liquid) (April to October)	✓			
• Ultra violet (UV) (April to October)		✓	✓	
• Migration path to UV				✓

As a baseline level of treatment, primary treatment is a hydraulic process and its capacity is established to be able to treat the full wet weather flow arriving at a treatment plant. Wet weather days can be as high as 3 to 4 times Average Dry Weather Flow (ADWF) due to the infiltration and inflow of unwanted rainwater entering the sanitary sewer system. Secondary and advanced treatment processes utilize biological treatment processes and are limited in treatment capacity to two times ADWF (2 x ADWF).

On wet days the flows that bypass secondary treatment are treated through primary or bypass treatment processes and blended with secondary effluent prior to discharge to the receiving environment. At all times the blended effluent must meet the secondary treatment effluent discharge standard of 25 mg/L BOD, 25 mg/L TSS.

In the North Shore, Fraser and Lulu Island Sewerage Areas the Liquid Waste Management Plan commits member municipalities to rainfall infiltration and Inflow reduction programs to progressively reduce the amount of wet weather flow arriving at the wastewater treatment plants. The Regional Engineers Advisory Committee is currently reviewing the municipal infiltration and inflow reduction programs including potential approaches to manage infiltration and inflow that originates from the private property service connections. These connections represent approximately half the length of pipe in the sewerage collection system.

NORTH SHORE WASTEWATER TREATMENT PLANT

As shown in Table 2, while the new NSWWTP is defined as a secondary treatment plant, the plant actually includes a number of features that improve the quality of the effluent beyond secondary, including UV and seasonal disinfection and 25% tertiary treatment, along with the ability to remove nitrogen and phosphorus in the future.

There is currently no environmental threat related to nutrient discharges to the marine waters. To achieve an initial level of tertiary treatment for nitrogen removal no significant capital investment is needed but additional annual operating costs totaling about $2.4 million are required for chemicals, electricity and labour. Energy and GHG profiles would be impacted if the nitrogen removal process is utilized.

Also included in the indicative design is tertiary filtration up to about 0.5 x ADWF, or about one quarter of the plant secondary design capacity, to produce reclaimed non-potable water for use within the plant and for external users from a standpipe for tanker truck connection.

The design adopted for the NSWWTP was approved by the Board in 2014 and the construction contract was awarded in 2017 to complete the project. The design build contract was awarded to ADapt (now Acciona) for a fixed price of $542 Million, inclusive of the optional effluent heat recovery system. A re-design of the tertiary disk filter installation for the North Shore plant to achieve 100% tertiary treatment (an effluent quality standard of 10/10 (BOD/TSS) measured by biochemical oxygen demand (BOD) and total suspended solids (TSS) for up to 2 x ADWF) would require the expansion of the gallery space to allow for extra banks of disk filters up to the full plant secondary design capacity of 2 x ADWF.

Based on the current plant design, the annual household cost for North Shore ratepayers is expected to rise over the next five years from $300 in 2019 to $609 in 2023 once long term debt is secured and the new plant is fully operational. Capital cost impacts are still under review.

IONA ISLAND PROJECT DEFINITION PHASE

The Iona Island Wastewater Treatment Plant is being upgraded to meet the secondary level treatment standard by no later than December 31, 2030. Work is underway on the Project Definition Report and the technical team has short-listed a range of treatment options for comparison and business casing using the triple-bottom-line approach. The options include base secondary treatment technology as well as technology that can provide tertiary treatment. In addition, the project team will examine advanced treatment technology that could be added to target micro-pollutants, including pharmaceuticals and personal care products. Cost estimates will be developed as the treatment options are refined.

MICRO POLLUTANTS AND ADVANCED TREATMENT

The southern resident Killer whales have been designated as Endangered under Canada's *Species at Risk Act*. One of the three threats identified by Fisheries and Oceans Canada for the Killer whale population is the bio-accumulation of chemical contaminants. Environment and Climate Change Canada has undertaken a review of contaminants of concern to the southern resident Killer whales. Their initial priority contaminants include, among others, legacy chemicals such as polychlorinated biphenyls (PCBs), pesticides, pharmaceuticals and personal care products, hydrocarbons, metals and biological contaminants. Input to develop a priority contaminants list was received from the Technical Working Group on Contaminants, which Metro Vancouver is a member along with, senior government (Environment and Climate Change Canada, Fisheries and Oceans, BC Ministry of Environment and Climate Change Strategy), their American counter-parts (National Oceanic and Atmospheric Administration, Washington Department of Fish and Wildlife), academic institutions (University of British Columbia and Simon Fraser University), and non-government organizations (Oceanwise, and Georgia Strait Alliance) .

Most of these contaminants are found in wastewater effluent in small concentrations (parts per million, billion or trillion). Conventional wastewater treatment, including tertiary treatment for nutrient removal and tertiary filtration, provides some benefit but is only marginally effective at removing most micro pollutants.

As part of the Iona Island project definition work, the technical team is exploring advanced treatment technology that could be added post tertiary treatment to target micro pollutants. Potential technologies include oxidation processes based on ozone and adsorption processes that utilize activated carbon. The development of a pilot testing program is necessary to prove the effectiveness of advanced treatment technologies at removing the priority micro pollutants and develop the scale and costs associated with the additional treatment step. Key members of the Environmental Monitoring Committee will be engaged in the development of a pilot testing program and partnership arrangements to undertake the work. Also, some research work is underway though the GVS&DD Sustainability Innovation Fund to assess adsorption of micro pollutants onto activated carbon created from biosolids.

LWMP REVIEW AND GVS&DD'S 30-YEAR OUTLOOK

In October of 2018 Metro Vancouver forwarded a request to the BC Minister of Environment and Climate Change Strategy to extend the review cycle of the *Integrated Liquid Waste and Resource Management Plan* (the current LWMP) by two years. Extending the cycle by two years will permit the updated plan to align with the outcomes of some important initiatives currently underway, including the project definition work for the Iona Island plant, sewer overflow reductions and actions on climate change. It is expected that a decision from the Minister on this request will be received in the near future.

The formal review and renewal of the LWMP will allow Metro Vancouver and its member municipalities to consider new actions related to liquid waste management that would continue to improve wastewater management to keep pace with a growing population. One of the initiatives will be enhanced levels of treatment at all five GVS&DD wastewater treatment plants. This is already being identified in the GVS&DD 30-year outlook currently under development.

New commitments in an updated LWMP that can be considered include the full technical investigations related to tertiary and advanced levels of treatment for all wastewater plants that would ensure continued protection of the receiving water bodies and reduce the levels of micro pollutants that are currently being discharged.

ALTERNATIVES

This is an information report. No alternatives are presented.

FINANCIAL IMPLICATIONS

Each wastewater treatment plant within the GVS&DD system has its own unique cost profile. Advanced treatment costs vary based on the size of the plant, availability of surrounding land, topography, geographic location, population served and receiving environment. Capital costs related to new infrastructure which will treat effluent beyond a primary level of treatment is cost shared by GVS&DD members on a 70% regional allocation and a 30% sewer area allocation (Tier 2 projects). Infrastructure costs related solely to growth are funded 100% by DCC's and operating costs for each wastewater treatment plant are funded 100% by each individual GVS&DD sewer area.

Unlike the GVWD which achieves economies of scale by sharing capital and operating costs on a fully regional basis, the GVS&DD shares capital and operating costs on a sub-regional basis resulting in a

much different decision-making and cost profile. The household impact for each sewer area varies considerably based on the unique circumstances of that sewer area. Consequently, seeking the most cost effective ways to treat wastewater to meet federal regulations both now and in the future is essential to the region's financial sustainability.

The review and renewal of the LWMP will allow consideration of new actions related to tertiary and advanced levels of treatment at all GVS&DD treatment plants. Costs estimates will be developed for each new action in the updated LWMP for the Board's consideration when adopting an updated LWMP.

SUMMARY / CONCLUSION

This report responds to two requests from the GVS&DD Board for information on tertiary treatment options for the North Shore and Iona Wastewater Treatment Plants and additional information about tertiary treatment as it relates to all five GVS&DD treatment plants.

Since its adoption by the provinces, territories and federal government in 2009, *The Canada-wide Strategy for the Management of Municipal Wastewater Effluent* defines a base level of secondary treatment for Canada and a science-based risk assessment process to identify if tertiary or higher levels of treatment are needed for a specific discharge location. The treatment plant discharges and receiving environment monitoring studies are reviewed by the Environmental Monitoring Committee, which was established in the Liquid Waste Management Plan approved by the BC Minister of Environment in 2002.

Levels of wastewater treatment follow a progression from primary, to secondary, tertiary and more advanced treatment steps, each resulting in an improvement in effluent water quality. Wet weather management is an important component of wastewater treatment to ensure that during extreme wet weather events the effluent does not drop below the secondary treatment standard.

As noted in Table 2 of this report, the Northwest Langley WWTP is being upgraded to tertiary level treatment due to the unique factors at that plant location which has enabled a cost effective advanced effluent treatment solution. The new North Shore WWTP is designed to an advanced secondary treatment level and has the ability to migrate to tertiary treatment in the future. Work is underway to complete the Project Definition Phase for the replacement of the Iona Island Wastewater Treatment Plant. Options being considered and business cased will include secondary, tertiary and advanced treatment options. The advanced options would specifically target removal of micro pollutants that have been identified as one of the key stressors impacting the southern resident killer whales.

Metro Vancouver is in a unique position in undertaking new scientific research due to its substantial financial investment in the GVS&DD Sustainability Innovation Fund which enables Metro Vancouver to leverage this fund on an annual basis to explore innovative technology, processes and research partnerships to respond to climate change. Metro Vancouver's research facility, the Annacis Research Centre located adjacent to the Annacis WWTP facility, is well positioned to undertake this new research on treatment technologies that will ensure Metro Vancouver remains a leader in the protection of the environment.

By 2021 work will commence on a review and update of the current *Integrated Liquid Waste and Resource Management Plan* approved by the BC Minister of Environment in 2011. There will be an opportunity to review the levels of treatment at all GVS&DD treatment plants and develop new actions for consideration by the GVS&DD Board.

References

1. 2017 GVS&DD EMQC Annual Report
2. LWMP Biennial Report