APPENDIX

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RESOURCE RECOVERY OPTIONS

MEMO

TO: CVRD LWMP TACPAC Committee

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SUBJECT: **CVRD LWMP Stage 2 - Resource Recovery Options**

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OVERVIEW

In recent years, there has been an increasing emphasis on recovery of resources that can be extracted from the wastewater stream or that can be produced during treatment. In British Columbia, the success of applications for grant funding assistance from senior government for design and construction of wastewater conveyance and treatment facilities often depend in part upon inclusion of resource recovery, which may include the following:

- use of reclaimed effluent for in-plant use, irrigation or other purposes;
- installation of heat exchangers in the wastewater stream for heating and cooling of buildings;
- production of biogas (methane) through treatment of waste solids, which can be used in combustion facilities designed for cogeneration of electrical power and heat or in boilers for hot water heating systems;
- use of digested waste solids as a natural solid conditioner/fertilizer, and/or use of waste solids as a feedstock to produce compost for household or commercial use;
- production of mineral pellets rich in nitrogen and phosphorus (struvite) for use as fertilizer; and
- use of hydroelectric turbines to generate electrical power from the outfall discharge.

The feasibility of the various resource recovery option must be carefully evaluated. The design and installation of resource recovery facilities can add substantially to the capital and operating costs of wastewater treatment facilities. If there are no potential customers for the recovered resources or if those customers are located far from the recovery location, investment in resource recovery may be inadvisable. Each situation must be evaluated on its own merits, beginning with identification of potential uses and users of the reclaimed resources. Brief discussions of each resource recovery option in the context of the CVRD LWMP are presented below.

RECLAIMED WATER

Some of the wastewater treatment options (namely Options 3 and 4) are designed to produce effluent quality that meets the requirements for use of reclaimed water. For Option 2, if one or more uses for reclaimed water are identified, the appropriate amount of secondary treated effluent can be diverted to a dedicated filtration and disinfection system to produce reclaimed water. As set out in the Municipal Wastewater Regulation, it is required to maintain a chlorine residual in the reclaimed water at the point of use unless the addition of chlorine will detrimentally impact flora or fauna, or at the point of use fecal coliforms remain below levels set in municipal effluent quality requirements for reclaimed water, and users are adequately informed regarding appropriate use of the reclaimed water. Disinfection of reclaimed water is normally accomplished through the addition of sodium hypochlorite (bleach).

Production of reclaimed water adds to the cost of treatment, so it is important to identify the potential market for this resource. It is normally cost effective to use a portion of the treated effluent for non-potable applications within the treatment plant itself (e.g., for equipment sprays, washdown water, landscape irrigation, etc.). This typically represents a relatively small portion of the total wastewater flow, but it does offset use of potable water at the plant. A small amount of reclaimed effluent is currently used at the CVWPCC for washdown in enclosed areas. Opportunities for expanding use of reclaimed water within the plant should be considered during design of future upgrades.

Offsite applications may represent opportunities for use of larger amounts of reclaimed water (irrigation, industrial use, or stream and wetlands augmentation). The economics of offsite use depend heavily on the distance from the reclaimed water production facility to the user. Other factors include the seasonal pattern of demand for water, the cost of alternative water sources, and the water quality requirements of the potential user.

In cases where a significant potential user of reclaimed water has been identified but the distance between the main wastewater treatment plant and the user makes the project unfeasible for economic reasons, it may be possible to locate a relatively small water reclamation plant near the user and divert some of the untreated wastewater to that location for treatment and use. The feasibility of this will depend on the amount of reclaimed water to be produced and other local factors.

A summary of the results regarding potential uses for reclaimed water from the February 2019 TAC/PAC meeting is shown in Table 1. As shown, a large number of potential locations for effluent reuse were identified. Detailed studies would be required for each potential location, to assess water quality requirements, capital and operating costs for pumping and conveyance of reclaimed effluent from the CVWPCC to the site, revenue potential to offset costs, additional treatment requirements, environmental impacts, and other site-specific factors. The conveyance distance is a very important factor, since capital and operating costs rise significantly as distance increases. This will be the primary limitation for many of these options.

Future upgrades at the CVWPCC could be designed with the potential for reclaimed water production in mind, so that additional levels of treatment can be added if and when users are identified, without costly reconfigurations of the treatment facilities.

Table 1 - Summary of Potential Reclaimed Water Uses - from February 2019 TACPAC Meeting

Use (at each site)	**Water Quality Requirement**	**Volume (m3/day, summer)**	**On Sewer?**	**Nearby Localities (0-4km)**					**Farther Localities (4-8km)**						**Remote Localities (>8km)**						
Per site		Greater than X		CVWPCC	Lazo Beach Area	Queen's Ditch farm area	Airport	Comox (Town)	KFN	Estuary Farm area	Courtenay (East)	Crown Isle Resort	Anderton Rd (South of Ryan)	Little River	Courtenay (West)	Anderton Rd (North of Ryan)	Portuguese Creek Valley	Royston	Union Bay	Denman Island	Texada Island
Stream augmentation	GEP/IPR	10,000	N			Y											Y		Y		Y
Agriculture -spray irrigation, field crops	GEP	100	N			Y				Y			Y	Y		Y	Y	Y	Y	Y	
Concrete mixing	GEP	100	N												Y						
Airport (all outdoor uses)	GEP	100	N				Y														
Golf Course (each)	GEP	100	N				Y	Y				Y					Y				
Wetland augmentation	GEP/IPR	100	N		Y																
Agriculture - spray irrigation, forage	MEP	100	N			Y				Y			Y	Y		Y	Y	Y	Y	Y	
Mining	MEP	100	N																		Y
Irrigation playing field/school	GEP	10	N					Y			Y	Y	Y		Y			Y	Y		
Airport (all indoor uses)	GEP	10	Y				Y														
Gravel washing	GEP	10	N								Y				Y						
Dust Control	GEP	10	N								Y				Y						
Car Wash	GEP	10	Y					?			Y				Y						
Transit bus wash	GEP	10	Y												Y						
Comox marina (boat washing)	GEP	10	N					Y													
Irrigation - municipal park	GEP	10	N					Y	Y		Y	Y	Y		Y						
Irrigation - cemetery	GEP	10	N					?			?				?						
BC Ferries Little River	GEP	10	N								Y				Y						
Irrigation roadside	GEP	10	N					Y	Y		Y	Y			Y						
HMCS Quadra	GEP	10	Y					Y													
Tree Farm (Xmas, timber)	MEP	10	N														Y	Y		Y	Y
Commercial nursery, greenhouse	MEP/GEP	10	N								Y		Y		Y	Y	Y				
Agriculture- subsurface drip irrig.	MEP	10	N										Y	Y		Y	Y	Y	Y		
CVWPCC	MEP/GEP	10	Y	Y																	
Industrial process	MEP/GEP/IPR	10	Y								Y				Y						
Commercial laundry	MEP/IPR	10	Y								Y				Y						
Public washrooms	GEP	1	Y					Y	Y		Y	Y		Y	Y				Y		
Rural residential	IPR	1	N		Y				Y				Y	Y		Y	Y	Y	Y	Y	
Flood irrigation of cranberries	Not allowed	-																			
Approx Total Water (m3/day, summer)				**10**	**100**	**1000**	**100**	**100**	**10**	**1000**	**100**	**100**	**100**	**1000**	**1000**	**1000**	**10,000**	**1000**	**1000**	**100**	**100**

HEAT RECOVERY

Extraction of heat from the wastewater stream at pumping stations and treatment facilities for space heating of buildings is becoming more common (the same system can also be used for cooling in summer). As with reclaimed water, heat recovery for use onsite at wastewater treatment facilities is generally the most feasible from a cost standpoint. Use of this type of system can be considered for incorporation into future upgrades at the CVWPCC.

If a potential user or users of heat is located near the pumping station or wastewater treatment plant, it may be feasible to expand the system to export heat to a nearby specific user (an example of such a system is in place at the Saanich Peninsula wastewater treatment plant, where heat is extracted from the effluent for use at an adjacent municipal swimming pool). In some cases, if there is high density development near the treatment plant, it may be feasible to install a District Heating System that circulates recovered heat through a heating loop for use by multiple customers. Due to the cost involved in installing a District Heating System, it is preferred if there is a year-round demand for the recovered heat (e.g., swimming pool, commercial laundry).

A summary of the results regarding potential users of reclaimed heat from the February 2019 TACPAC meeting is shown in Table 2. A small number of existing potential users were identified, some within 2 km of the CVWPCC. As with reclaimed water, the distance between the facility where the heat is recovered (CVWPCC or pump station) and the user will have a significant impact on the economics of heat recovery.

Table 2 - Summary of Potential Reclaimed Heat Users - from February 2019 TACPAC Meeting

Use Category	Use	Existing	Within 2km CVWPCC?
Process Heat (year round)	CVWPCC Biogas processing	N	Y
	Lumber drying	N	N
	Fibre processing	N	N
	Biofuel processing	N	N
	Distilling	N	N
	Commercial laundry	N	N
	Other Industrial	N	N
	Airport (hot water)	Y	N
Space heat (winter)	CVWPCC space heating	Y	Y
	Rec. Centre	N	N
	School	N	N
	Commercial greenhouse	N	N
	Airport (space heat)	Y	N
	Houses (via district heat/reclaimed v	Y *	Y

Future upgrades at the CVWPCC (and at major pumping stations) could be designed with the potential for heat recovery in the future, so that the required facilities can be added if and when users are identified, without costly reconfiguration of the existing facilities. A detailed study to evaluate feasibility is recommended prior to implementing a heat recovery system.

PRODUCTION OF BIOGAS

At larger wastewater treatment plants (service population of at least 50,000 to 100,000 people), it may prove economical to install anaerobic digestion facilities for treatment of waste solids. Anaerobic digesters reduce the amount of solids (typically by approximately 50%) and produce methane gas that can be scrubbed and then used in cogeneration engines for production of combined heat and electrical power for use at the treatment plant, or the gas may be cleaned to the required standard for sale to the local natural gas utility. The residual solids remaining after anaerobic digestion, generally referred to as biosolids, are suitable for beneficial use provided that regulatory criteria are met (e.g. application to soil as a natural fertilizer/soil conditioner or feedstock for production of compost). Anaerobic digestion is not currently practiced at the CVWPCC, and economies of scale mean that it may not be economical at present; however, new technologies are always in development; the economics will also be affected by the potential to defer expansion of composting facilities, and by the capacity of the local market to accept the compost product. Digestion may be considered in future as a possible resource recovery strategy when the CVWPCC is next upgraded.

BENEFICIAL USE OF TREATED SOLIDS

Where digestion of waste solids is practiced at wastewater treatment plants, the solids product of digestion (biosolids) can be used as a soil conditioner and natural fertilizer, proved that it meets all of the required regulatory standards. Land application of treated biosolids to fertilize agricultural land, for reforestation, and for reclamation of disturbed sites is commonly practiced in British Columbia; however, this can be a costly undertaking, depending on the transportation distance to the biosolids use site and the topography of the site. In some cases, there has been public resistance to land application of biosolids, due mainly to concerns over odours and the presence of potentially harmful substances.

The CVWPCC dewaters waste solids and transports the dewatered cake to a nearby site for use as a composting feedstock. This does not require digestion prior to composting, and it produces a product called SkyRocket that is much more marketable than dewatered biosolids. Production of Class A compost (SkyRocket) as practiced by the CVRD allows sale of the compost product to households and commercial users. Proceeds from the sale of compost help to offset operating costs for solids handling. This is a sustainable strategy for beneficial use of treated wastewater solids as long as the local market can absorb the compost; at some point, digestion to reduce the solids stream to composting may be beneficial to reduce loading on the composting facilities and to reduce the amount of compost produced (see above).

EXTRACTION OF NITROGEN AND PHOSPHORUS FOR FERTILIZER PELLETS

Depending on the treatment processes used, some wastewater treatment plants produce relatively low-volume side streams of high-strength wastewater that would normally be routed back to join the plant influent wastewater for treatment (e.g., water produced as a result of dewatering digested waste solids or waste biological solids from biological nutrient removal processes). For these high-strength side streams it is in some cases economical to extract nitrogen and phosphorus in a small treatment reactor that causes precipitation of a mineral called magnesium ammonium phosphate, commonly referred to as struvite. The struvite pellets can be marketed as a commercial fertilizer, offsetting the production and use of chemical fertilizers. This would not be feasible at the CVWPCC at present, due to economies of scale and the treatment processes currently in use; however, it could be considered for use in future, depending on what processes are implemented at the treatment plant.

HYDROELECTRIC TURBINE FOR GENERATION OF ELECTRICAL POWER AT OUTFALL

In some cases where there is a large elevation difference between the treatment plant and the receiving water (i.e., the land section of the outfall has a steep downward slope), it is possible to install a small hydroelectric turbine to generate electricity. In our experience, this is not cost-effective at smaller plants, even if there is a large head loss available on the discharge to drive the turbine. In the case of the CVWPCC where there is minimal head loss under certain tidal conditions and effluent pumping is required, this type of energy recovery is unlikely to be a viable option.

SUMMARY

In general, resource recovery options must be carefully evaluated for feasibility before implementation. Through this LWMP process, a number of potential applications for reclaimed water and heat recovery were identified by the TAC/PAC committee though the primary limitation for feasibility of these potential resource recovery applications will be identifying users and the long-distance conveyance requirements.

In the future when upgrades to the CVWPCC are undertaken, studies should be completed prior to design to evaluate the addition of resource recovery processes and their feasibility. This may include reclamation of effluent, extraction of heat from the effluent for space heating and cooling, struvite crystallization for fertilizer production, or anaerobic digestion for generation of biogas where analysis shows that this is economically attractive.

Note that technologies for treatment of wastewater and waste solids are continually evolving, and research and development are ongoing. If resource recovery is not considered feasible at the time of CVWPCC upgrades, designs could incorporate flexibility so that facilities for resource recovery can be added to the plant without major disruptions or modifications to the existing facilities in the future.