Liquid Waste Management Plan
Technical Memorandum

LWMP Technical Memorandum #5

TO:	Wastewater Advisory Committee
SUBJECT:	Receiving Environment
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1.0 BACKGROUND

The Village of Cumberland (VoC) wastewater treatment system discharges into Maple Lake Creek, which flows into the Trent River and eventually Baynes Sound. The discharge of phosphorus from the VoC lagoons into Maple Lake Creek has been continuous for over a hundred years. While there have been concerns raised in the past regarding the wastewater effluent phosphorus loading to the river and resulting excess primary productivity levels as evidenced by elevated chlorophyll-a levels measured in the Trent River, as well as the lack of an effluent disinfection process, the discharge from the lagoons is of significant value to the receiving environment as the majority of the water flowing in Maple Lake Creek and the upper reaches of the Trent River during the summer is from the lagoons.

The summer 2017 environmental sampling program described in Technical Memos #3 and #4 demonstrated the natural wetlands along Maple Lake Creek have responded and adapted to the nutrients contained in the lagoon discharge, passively absorbing and taking up over 97 percent of the nitrogen and phosphorus as well as achieving an overall 4-Log reduction in fecal coliforms. The concept of having wetlands polish the effluent from the wastewater lagoons has been the subject of previous studies carried out on behalf of the VoC including reports by Ker, Priestman & Associates (1991), CK Ventures et al. (1998) and Wetlands Pacific (2002). However, these were largely based on constructing wetlands either as a principle means of wastewater treatment, replacing the existing lagoon treatment system, or as an additional level of (add-on) treatment – versus enhancing and utilizing the existing natural wetlands within Maple Lake Creek.

As noted in Technical Memo #6, the environmental impact of diverting wastewater effluent from Maple Lake Creek would be expected to have a significant detrimental impact on Maple Lake Creek and the Trent River, as a large proportion of the water in those streams during the summer months originates from the lagoons. As noted by Wetlands Pacific (2002) there are a number of limiting factors to productivity in the Trent River, but the low water flows due to extensive watershed disturbance, removal of beavers, and reduced mountain snow packs due to climate change are probably the main limiting factor to productivity within the Trent River, particularly during the late summer when there are little if any surface flows.

Consequently, the receiving environment within Maple Lake Creek and the Trent River will continue to be the primary focus of environmental impact considerations for future wastewater effluent discharges from Cumberland, regardless of whether the water is directly released to Maple Lake Creek, indirectly released through a discharge to the wetlands to the north, or seasonally discharged through storage ponds, as discussed in Technical Memo #6.

The most comprehensive environmental resource survey carried out to date is the 2001 survey conducted by Mimulus, Biological Consultants (Mimulus) in 2001, in conjunction with considerations for plans for the construction of additional lagoons and constructed wetlands.

2.0 MAPLE LAKE CREEK

Maple Lake Creek (MLC) flows south past the VoC wastewater sewage lagoons, from Maple Lake to the Trent River, a distance of about 4.5 kilometers.

Water enters Maple Lake Creek from several sources. Water from Maple Lake travels via a series of wetlands to Maple Lake Creek which has been straightened along the section that passes past the lagoons. Treated wastewater effluent from the lagoons is released into the creek, and the water then continues to flow towards Dunsmuir Road, where it passes under the road via a culvert. Additional water enters the creek from storm and overland flows along the length of MLC.

Additional water enters the study site from storm and overland flows. Storm water enters the northwestern part of the site from Cumberland Road, where it flows both to the south and east. Overland flow also enters the site from the hillside along Union Road and from the forest on the western side,

The stretch of MLC just downstream of the outfall discharge consists of an industrial area to the west and willow and grasses to the east, classified as a shrub swamp, beginning just north of the discharge from the wastewater lagoons and extending south along the east bank of the creek. The area is dominated by Pacific willow and a mixture of reed canary grass and other introduced grasses. The east bank becomes a wet meadow/shrub swamp further downstream dominated by Reed canary grass and hardhack with patches of larger shrubs such as willow and dogwood. The soil in this area is silty with increasing clay content at deeper levels. The creek channel itself for the first kilometre downstream of the lagoons is a straight, man-made ditch, originally cut into the peat as an agricultural drainage channel. It is very flat gradient with no natural ponding.

The reach from one to three km downstream of the lagoons is a meandering natural stream bed, still of very low gradient, and with a series of beaver ponds. These ponds have created wide, shallow ponds over the original soil surface, and have been colonised principally by reed canary grass.

From three to 4km downstream of the lagoons, the stream becomes a steeper gradient, rock bed stream, with numerous cascades and pools. The in stream rocks support a biofilm of algal growth. At 4km downstream of the lagoons, Maple Lake Creek enters the Trent River.

The lower reaches of Maple Lake Creek, directly above Trent River, are accessible to fish from Trent River, but the upper reaches past the lagoons are blocked from fish migration as the creek ends in marshland. The physical habitat in the first two reaches was concluded by Mimulus (2010) to be optimal for rearing salmonids. "*Cover and refugia in the form of cutbanks, pools, riparian vegetation, and woody debris represent critical components for salmonid nursery streams and each of these are fairly well represented in the lower reaches of Maple Lake Creek*". And it is noted that "*at a minimum, it will be important to maintain the current water quality level in Maple Lake Creek to protect the salmonid populations and the downstream fish habitat on which they depend*".

It should be noted that most of Maple Lake Creek is on privately owned land. The reach from 0.7 to 1.7km downstream of the lagoons is within land owned by Trilogy (a property developer), and the reach from 1.7km to the Trent is within land owned by Timberwest Forest Ltd. Even though it is privately owned, the owners are restricted from causing harmful alterations to the creek habitat under the BC Riparian Areas Regulation. Riparian assessments are required as part of any development proposals near creeks, including wastewater treatment plants! The land ownership is shown on the Cumberland Land Ownership map, which is attached to this memo.

3.0 TRENT RIVER

The Ministry of Environment administers control over phosphorus release to the environment by developing recommendations on phosphorus levels in streams and lakes. For protection of aquatic life, it is 100 mg/m^2 of chlorophyll a and 50 mg/m^2 for aesthetics.

Chlorophyll-a measurements taken in the Trent River below the confluence of MLC are cited as being excessive include three data points of 10, 20, and 30 mg/m^2 taken during the summer of 1997 (EMSDRR, 1997).

In 2005, as part of the Waste Liquid Management Planning process, the VoC and BC Ministry of Environment carried out a study in the Trent River to investigate the possibility of discharging effluent from the lagoons only during the evening to minimize phosphorus uptake in the river that would otherwise occur during the daytime. Unfortunately, that study was not successful for a number of reasons, but it did serve to provide some information on the chlorophyll-a levels within the lower reaches of the Trent River – which the Ministry attributed to the phosphorus released from the VoC lagoons.

The Ministry report (MOE, 2011) on a phosphorus study in the Trent River concluded the lower reaches are subject to very high phosphorus inputs from the Village of Cumberland. The report inferred the lagoon discharge was the primary source of phosphorus released to the Trent River. However, the lower reaches are also affected by many sources of phosphorus-laden drainage and stormwater runoff that are not considered in the report. Noting that "coastal streams in BC are typically nutrient starved", the report comments that these streams are also more susceptible to algal growth and, while phosphorus addition at low levels can benefit such streams, "*phosphorus loading can quickly produce high and problematic amounts of algal biomass if not carefully managed*". The West Coast Region of MOE have developed objectives for total phosphorus on Vancouver Island, based on Vancouver Island specific data, and have established ambient water quality objectives of a maximum total phosphorus of 7 ug/L and a May – September average of 5 ug/L (i.e. 0.005 mg-P/L). As the summer average coincides with the analytical detection limit for phosphorus, this means the objective is to achieve a non-detect level within the Trent River.

The MOE report on phosphorus and primary productivity in the lower reaches of the Trent River indicate the chlorophyll α levels as high as about 160 mg/m^2 (reference MOE, 2005 unpublished data), which exceeds both the aquatic life protection and aesthetics criteria.

The Trent River is affected by phosphorus contributions from many point and non-point sources within the catchment, and recommended chlorophyll-a levels are expected to be exceeded during the lowest flow periods.

4.0 WETLAND AREA TO THE NORTH OF THE EXISTING LAGOONS

The area to the north of the lagoons is a flat wetland area of peat soils. It was extensively farmed in the 1930's but was abandoned in the 50's. In that time, grasses, shrubs and trees have established, as further described below. In 2001, as part of Cumberland's then LWMP planning, it was proposed to build an engineered wetland on this area, as part of the wastewater treatment system. This area is now under consideration as a distribution area for the final treated water from the lagoons. This would supply water in the dry summers and allow for a planned revegetation and habitat enhancement program.

The wetland area is owned by the Village of Cumberland, and is part of a larger area of land around Maple Lake Creek, that was gifted to the Village under the Federal "Eco-Gift" program. Any activities planned for these lands must ot compromise their habitat function.

Vegetation in the wetland area to the north of the lagoons is described by Mimulus (2011) as receiving ground and surface water drainage from the wooded lands just to the north, and is described as having a high incidence of introduced species as well as a large diversity of habitat types, with evidence of many different mammal and bird species was apparent in this area. The terrestrial survey conducted by Mimulus describes seven distinct communities in this area:

1. Hardhack/Grass/Dogwood

   Higher density of taller shrub species (red- osier dogwood, Pacific crabapple, and several species of willows) at the northern end and more graminoid species in the southern end. Hardhack dominates the center of the area, and co-dominates with grasses along the southern end closest to the lagoons. The area includes many introduced species along the western side of this area.

2. Hardhack

   A small area composed almost exclusively of hardhack is located to the east of the Hardhack/Grass/Dogwood community noted above.

3. Bracken Fern/Labrador Tea

   This is a large community that includes clumps of tall shrubs, pocket bogs, and open areas dominated by bracken fern, sedges and various shrub species (Mimulus, 2011). The typical bog plants in this area include Labrador tea, sphagnum moss, bog laurel, and cloudberry. The substrate beneath this area is described as being primarily organic with pockets of deep (>40 cm.) peat.

4. Bracken/Hardhack

   Supported a variety of plant species, Bracken fern is the most abundant species in this area with small areas of salmonberry, large-leaved avens, sword ferns, and vanilla leaf, as well as pockets of species typically associated with wetlands such as crabapple, hardhack and sedges. The organic substrate has deep mesic peat horizons.

5. Crabapple/Sedge

   This area is a shrub swamp with most of the species exceeding three meters in height and includes Pacific crabapple, cascara, dogwood, and mountain ash. Sedges, bracken fern, creeping buttercup and lady fern are also common under the shrubs.

6. Wet Meadow

   Water flows into this area from the wooded areas to the north and west, and it is dominated by introduced grasses. Water-filled channels, natural and anthropogenic, form a network through the area, and contribute to the mounded topography. Obligate wetland species in this area include cattails, burreed, and duckweed, and Hardhack is also common.

7. Willow Thicket

   This area located along the northern boundary of the sewage lagoons is dominated by a good diversity of tall willow species as well as red alder, cascara, black twinberry, and a few cottonwood trees. There was evidence of flooding in this area as well as wildlife trails and bedding sites.

The habitat that is provided by the bog communities north of the lagoons and west of Maple Lake Creek are considered to be sensitive and environmentally valuable; however, the 'sensitive' area does not include the grass-dominated habitat (Wet Meadow community) located immediately adjacent and to the north of the lagoons. The

introduction of reclaimed wastewater to this grass-dominated habitat would require a hydrological assessment to assess how water recharge to the bog would affect the dispersion of effluent from the lagoons. Bogs develop under nutrient poor conditions, and the addition of nitrogen and phosphorus from the lagoon effluent lagoons could have a detrimental effect on the adjacent bog habitat. Offsetting this concern is the augmented wetlands may be enhanced adding an additional type of wetland habitat to the existing mosaic.