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Discussion Paper No. 1

Regional District of Kitimat-Stikine

Stage 3 LWMP Communal Wastewater Treatment Effluent Disposal Options

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Stage 3 Liquid Waste Management Plan

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1 Effluent Disposal Options

During the public open houses for Stage 2 of the LWMP, the topic of the location and type of effluent disposal for the proposed "1st Avenue" wastewater treatment plant came up and was briefly discussed. Three options were briefly discussed including discharge to ground, discharge to Granite Creek or discharge to Lakelse Lake via a submerged outfall. Since each of these options has positive and negative attributes, and the selection of the disposal option will affect the overall reception and final approval of the project, it is important to discuss these options further. The intent of this discussion paper is to provide further information about these three options.

1.1 Background

Many of the properties along 1st Avenue on the east side of Lakelse Lake are well within the flood plain and are in a normally high groundwater area. This makes the proper and sustainable operation of individual septic tank and disposal field systems very problematic, if not impossible. Although there are technical solutions for these situations, including individual secondary treatment systems, as shown in Stages 1 and 2 of the LWMP, the cost of these solutions is significantly higher than that for single septic tank systems. During Stages 1 and 2 of the LWMP, the option of servicing these properties with a pressure sewer system with the collected wastewater going to a treatment plant located near the Highway end of Lakelse Lake Lodge Road was put forward as a viable solution to the existing septic tank systems and their problems. This communal collection and treatment option was shown to be less expensive on a per lot basis than the individual secondary treatment options.

The treatment plant that was conceptualized was a membrane-bioreactor (MBR) with ultraviolet (UV) disinfection. This combination of treatment processes would produce a very high quality effluent that would meet the Ministry of Environment's Municipal Sewage Regulation unrestricted reuse, reclaimed water, standards. Technically, treated effluent of this quality could be disposed of or reused in many ways, including stream flow augmentation and irrigation of crop lands and golf courses. However, having an effluent that can technically be discharged to ground or surface waters without concern for impacts, does not mean that these alternatives are immediately acceptable to the public. The following sections discuss the disposal options and the potential for reuse.

2 The 1st Avenue Communal Treatment Plant Effluent Disposal Options

There are three effluent disposal options that need further discussion. These include discharge to ground, discharge to Granite Creek or discharge to Lakelse Lake via a submerged outfall. These discussions are found in the following sections of this discussion paper.

2.1 Disposal to Granite Creek

The disposal of the high quality treated effluent to Granite Creek would be via a short outfall pipe into the Creek. Care would be taken to design the outfall pipe to protect it from damage due to rock movement during high creek flows. During installation, the proper care and attention would be required to complete the construction and commission during an approved Department of Fisheries "window" with as little impact to the creek bed as possible.

The effluent from the treatment plant would be mixed with the flow in the creek through the use of several small diffusers (short riser pipes with special one-way flow valves). Based on the expected quality of the effluent and the degree of mixing and turbulence in the creek, it is very likely that a short distance downstream from the outfall, it will not be possible to find any influence on the creek water quality from the effluent, at least during most flow conditions and especially under high flow conditions. Under extremely low flow conditions, monitoring and sampling might show a small influence on the water quality. However, because of the natural metals concentrations in the Creek water, it is possible that the influence might actually show to be a small decrease in metals concentrations (because the effluent will likely be lower in metals concentrations than the creek).

The main concern about this disposal option would be the perception that the effluent would negatively impact the fish in the creek. The second concern would be about pathogens in the creek and on the beaches adjacent to the mouth of the creek. Based on our expectations of the effluent quality, it would most likely meet the Province's guidelines for aquatic life and recreational water contact sports even before it is mixed with the Creek water. It should be noted that some of the metals concentrations in the creek water might already be naturally higher than the corresponding Aquatic Life guideline. In this case, the addition of the effluent could actually improve the net metals concentrations (by dilution). The pathogen content would meet the Ministry of Health body contact (swimming) requirements of less than 200 fecal coliforms per 100 mL before the effluent leaves the treatment plant. In addition, the creek water is very likely to be colder (and, therefore, denser) than the surface water in the Lake during the summer. This will cause the creek water to "dive" beneath the surface of the lake, further protecting the beaches from any real or imagined impacts. As a result, after dilution and dispersion in the creek and the lake, and the diving "plume", there would very likely be no real issues with the actual water quality and pathogen counts in the water as a result of discharge of treated effluent to Granite Creek.

The cost to construct a Granite Creek discharge would very likely be the least cost of the three options.

2.2 Ground Disposal

Ground disposal would involve one of two sub-options: via a subsurface system or via a rapid infiltration basin. The subsurface disposal option would be based on either perforated pipes, much like a septic tank disposal field or a subsurface infiltration gallery based around a series of open-bottomed buried plastic arch/tunnels. Both would discharge the high quality effluent to the ground and, hence, to the groundwater flowing towards the lake.

The rapid infiltration basin option would involve creating a unlined bermed basin with a sand "floor" over a pea gravel and shot-rock base. The intent of the basin would be to purposely "leak" the high quality effluent into the ground and, hence, to the groundwater that is flowing towards the lake.

Regardless of whether the high quality treated effluent entered the ground and groundwater via a subsurface disposal system or a rapid infiltration basin, the end effect would be much the same. There would be a "plume" of treated effluent that would be flowing towards the lake, mixing with the existing groundwater as it flows. There would potentially be an increase in dissolved ions within this plume, relative to the groundwater quality. However, because the groundwater in the area is relatively high in dissolved minerals, particularly metals, the measurable change in these ion concentrations will likely be very low.

The property owners down gradient from the ground discharge, e.g. those living on Kroyer and Kreston and portions of 1st Avenue would likely have concerns about the impact of the wastewater treatment effluent discharge on their well water quality. While such concerns are not totally without foundation, i.e. the treatment plant effluent is not drinking water quality water, the truth is the existing groundwater "aquifer" is not confined or protected from human or animal pollution under the current conditions. This is especially true when it is noted that these same properties currently discharge comparatively very poor quality septic tank effluents with very high pathogen contents to the groundwater under the current scenario. On this basis, under the current situation, anyone with a drinking water well in that area is taking a health risk if they don't properly disinfect their well waters before they drink them. As a result, it is quite likely that collecting and treating the wastewaters from the 1st Avenue area (including Kreston and Kroyer) and then discharging the treated high quality effluent to the ground could actually be an improvement to the existing situation. Disinfection of the well water would still be prudent but the disinfection efforts required to meet the required pathogen kills would be easier to achieve than the existing situation.

One benefit of discharging to ground would be the potential for the ground to further treat the already high quality effluent before it contacts Lakelse Lake. An example of this additional treatment would be the adsorption of phosphate on the sands and gravels between the point of discharge and the Lake. This is being done in communities such as Keremeos, which uses rapid infiltration basins and groundwater flow through sands and gravels to protect the Similkameen River from phosphorous, which can induce algal blooms, also a concern at Lakelse Lake.

The cost of developing either a sub-surface disposal system or a rapid infiltration basin system would likely be higher that a direct discharge to Granite Creek, but much less costly than an outfall directly into the Lake.

2.3 Discharge to Lakelse Lake Via an Outfall

An outfall is a relatively large diameter pipe, say 300 mm (12 inch) to 600 mm (24 inch) diameter pipe that would extend from the treatment plant into the lake. The pipe would be buried in a trench in an easement between the plant and the lowest recorded lake level and then be exposed from that point to its terminus, further out in the lake, at an appropriate depth. The exposed section on the lake bottom would be weighed down with concrete weights that would be bolted around the pipe. The pipe would most likely be thermally-welded ("butt-fused") high density polyethylene (HDPE) because the material is very impervious to chemical attacks and is very forgiving relative to impacts from boat anchors, etc.

The discharge end of the outfall will have several discharge risers equipped with one-way valves to help distribute the high quality effluent in to the lake. The location of the end of the outfall would be selected laterally and by depth to help minimize potential impacts. There would several concerns about an outfall into the lake. These would likely include:

- Impacts on lake water quality including pathogens and nutrients such as phosphorus.
- Impacts on the formation of ice on the lake.
- Fishing lines and/or anchors getting tangled on the outfall.

The end of the outfall would be located on the bottom of the lake at a depth that would result in the effluent being discharged into a thermodynamic "trap". This trap is set-up because the effluent from the treatment plant will likely be in the 10°C to 18°C range. For most of the year, is warmer than the water temperature in the deepest parts of the lake, even in the hottest months of the year. As a result, the effluent will initially rise away from the outfall due to its lighter density. As it rises, it will mix with the lake water and, at some point in the rising mixture, the temperature will be the same as the natural lake water. At that point, the effluent plume would cease to be buoyant and further rise of the plume is stopped, i.e. the plume is trapped well below the surface of the lake. Based on the target effluent quality prior to discharge, with a dilution from the outfall diffusers likely in the 1:100 range, at that point, it would likely be impossible to sample the water at the trapping depth and determine that there is any difference between that water sample and anywhere else in the Lake with respect to pathogens, phosphorus or any other chemical or biological parameter.

Ice formation will most likely not be impacted by the effluent discharge. In the winter, while the effluent plume will still rise based on thermodynamic buoyancy, it may not be completely trapped below the water surface. However, the temperatures would likely only be marginally different than other surface temperatures in other points in the lake. Based on the fact that the natural hotsprings in the area don't seem to have a significant impact on ice formation on the lake, it is extremely unlikely that the much cooler effluent, e.g. 10°C effluent versus 80°C hotsprings water, would have any impact on ice formation.

There is definitely a possibility that there could be some snagging of fishing lines on the outfall if the fishing lines are allowed too sink to close to the lake bottom during a trolling run. To mitigate this, the location of the outfall will be established with signs and alignment markers so fishers know where to pull up their lines. In addition, the outfall line would be buried in the lake bottom from the shore to lowest recorded lake level (and then a bit further) to help decrease the likelihood of snags. Since the pipe itself is round and the edges of the concrete weights can either be round or beveled to help eliminate snags, the likelihood of a significant snag on exposed section of the outfall itself is quite low. The snags might be more associated with weeds establishing a foothold on the concrete blocks in the shallowest exposed section where light penetration would still permit weed growth.

Construction of an outfall would be the costliest option of the three discussed in this paper, by a large degree, based on both the treatment plant to shoreline land section and the shoreline to effluent diffuser submerged (weighted) section.

3 Reuse Options

The quality of the proposed 1st Avenue service area wastewater treatment plant effluent would make effluent reuse a possibility. The possibilities for reuse include:

- Toilet flushing and lawn irrigation
- Forestry irrigation
- Golf course irrigation

Toilet flushing would require the creation of a reclaimed water distribution system (using purple HDPE pipe) and special considerations for plumbing within the buildings. While this is technically possible, there would be concerns by the public about the safety of such a system, e.g. animals drinking from toilets and/or toddlers playing in the toilet water. Similarly, the same water could be used to irrigate private lawns. There would be concerns about the risk or children and/or animals coming in to contact with this recycled water.

Forestry irrigation would require creation of a reclaimed water pipeline to the nearest forestry area, e.g. the Onion Lake area, where the water could be sprayed out into the trees with the benefit being increased rate of growth during the relatively dry summer months. During the winter, such irrigation would be of no benefit or problematic.

Golf course irrigation would be a seasonal effluent reuse. It would require the development of a golf course nearby, e.g. at Mt. Layton Hotsprings. Typical agronomical rates of irrigation are in the order of 25 mm (1 inch) per week. Above that rate, irrigation would be more of a ground disposal technique.

4 Conclusions

By having a treatment plant capable of producing a high quality effluent that could be used in an unrestricted reuse situation, the likelihood of a real impact from discharge to Granite Creek, the ground or Lakelse Lake is very low. Nevertheless, the selection of the actual disposal method and location will be influenced by public perception and opinion. For the purposes of this planning exercise, it may be expedient to simply theoretically choose the most costly option, the Lake outfall, and then use the cost of that option in the discussion of the financing of the implementation of the LWMP.