THE MUNICIPALITY OF THE VILLAGE OF LIONS BAY

INFRASTRUCTURE COMMITTEE MEETING
OF THE VILLAGE OF LIONS BAY
HELD ON THURSDAY, FEBRUARY 28, 2019 at 7:00 PM
COUNCIL CHAMBERS, 400 CENTRE ROAD, LIONS BAY

AGENDA

1. Call to Order

2. Appointment of Recorder

3. Approval of the Agenda

4. Public Questions & Comments

5. Delegations

A. Marek Sredski – 260 Oceanview Road (Page 3)

6. Approval of Minutes

A. Infrastructure Committee – November 26, 2018 (Page 9)

7. Business Arising from the Minutes

8. Unfinished Business

A. Magnesia Status Update (No Update)
B. Oceanview Stormwater System (No Update)

9. New Business

A. Kelvin Grove Wastewater Treatment Plant (WWTP) – Failure, Current Status, Prognosis
   i. Kelvin Grove WWTP Update and FAQs (Page 13)
   ii. 2018 Kelvin Grove WWTP Annual Report (Page 23)
   iii. Membrane Bioreactor Packaged Plants

B. Infrastructure Committee Terms of Reference – Review (Page 53)

10. Public Questions & Comments

11. Adjournment

12. Next Meeting – March 28, 2019

THE MUNICIPALITY OF THE VILLAGE OF LIONS BAY

DELEGATION REQUEST FORM

Please forward your Delegation Request Form to the Village Office by 12:00 pm, the Thursday prior to the regular Council meeting. Delegations may speak for a maximum of 10 minutes total.

Today's Date: February 21, 2019 Council Meeting Date: February 28, 2019

SUBJECT OF DELEGATION I wish to speak before the Council regarding:

Drainage problems on Oceanview Road

SUPPORTING MATERIAL I will provide additional information in advance of the Council meeting:

(by 12:00 pm the Thursday prior to the Council meeting so that the material can be included in Council package.)

Agenda of presentation
Information on:
- incorrect approach proposed
- proper solution to the problem

ACTION. The specific action I would like Council to take is:

1. Make available large scale map showing Oceanview Road details

2. Make available information submitted to the village office few year ago: That volume of water at the tunnel documented and photographed including comparison to very similar condition at lover Kevin Grove street

3. Carefully evaluate presented information including submitted document

NAME AND ADDRESS OF SPEAKER FOR THE DELEGATION:

Name: Marek Sredzki
Signature: [redacted]
Organization (if any):
Address: 260 Oceanview Road
Phone: [redacted] Fax:
Email: [redacted]

Note: A telephone number (where a message can be left with a person or voicemail), fax number or email address is required so that we can contact you in a timely manner.

To:

The Village of Lions Bay Mayor, Council and Infrastructure Committee

Re:

Water drainage problems on Oceanview Road

We strongly advise completing the existing drainage system on Oceanview Road and will show that re-instating the underground drainage to Rundle Creek will be ineffective at solving the problem as a whole and yet would be a far more expensive solution.

We ask that this report be provided to the consultants, ISL Engineering and Land Services Ltd. immediately so they can consider the years of valuable history underlying this situation.

Reason 1 Difficult task and expense of digging up the easement

From 2002, the old pipe between Oceanview and Rundle Creek was freezing over creating a blockage, so the water was badly flooding the downslope residence at 260 Oceanview in the winter. The culvert's entry was often plugged with debris creating similar problems. After the pipe rusted, more damage was caused when water was undermining the 260 Oceanview foundation for many years creating permanent damage.

In November 2004, 260 Oceanview residents had researched and recommended to the village a solution of inserting a flexible smaller diameter culvert type pipe to solve the leakage issue. That was rejected by the village authority in 2005.

The village maintenance department created a more expensive, but better permanent solution, of installing a new culvert crossing the street above 270 Oceanview driveway towards the trench below 245 Oceanview.

If a new pipe is installed to and through the easement today, it will have to be twice as long as previously since the starting point would be much higher up the street. This time, it will have multiple bends, therefore, most definitely, a new pipe would create problems with plugging even sooner than before.

To install a new pipe a contractor will have to:

- Destroy the concrete plug that was poured under 270 driveway.
- Excavate through the 270 driveway and replace it with new driveway and rendering the driveway unusable during the process
- Remove and replace all the large rocks that were deposited to hold 270 upper area – placed by village suggestion
- Use mid-size excavator to do the work.
- Destroy some 20 matured cedars in the process, some are 30 years old. Many of these cedars were previously destroyed without notice to the residents who had to then replace them at their expense. (These trees would have been removed and replaced if there was proper communication in advance).
- Destroy the garden area village allowed/forced 260 residents to create.
- Excavate a long trench in depth of 1.5 m to 4.0 m – that would be very difficult as there is no room for soil removal and temporary storage.
- Excavator work could endanger the power and communication lines going three ways over the area.

- It would permanently weaken 270 walls holding 270 sewage field.
- The trench would have to cross perpendicular to three culverts that run water from the underground creek underneath 270 downward. Consequently, those culverts will have to be repaired.
- 50% of old pipe would have to be removed with serious difficulty and potential damage to the back wall of 260 house.
- Fresh water lines to 260 and 270 will have to be removed and later replaced - denying water supply to 2 families for several days.
- Any mistake with the excavator's spoon could also damage the high-pressure water lines laying below and that would be a real disaster. For safety reasons, the main water supply to all residents of Kevin Grove will have to be closed for several days.
- The new pipe will have to end at the level of the creek not to create the land damage and soil erosion.
- Due to the previous damage to the foundation of 260 caused by leaking original culvert installed by the village, the owners will demand, by all available legal methods, for the village to replace the damaged house's perimeter rain water drainage system and water proof the outside wall, during the pipe installation process.

Diverting water from north of 270 alone is not a solution since all the other water that drains down the section of Oceanview between 245 and 180 would still drain into the properties to the west or downslope of it. Any solution must include the cost of ensuring this section between 245 and 180 Oceanview is watertight or the primary purpose of the project will not be satisfied and at the realistic cost of over $150,000.

The cost estimate indicated in one of the documents on the village website had to be done by someone not understanding the level of difficulty required.

Reason 2 Simple and inexpensive method of draining water along the entire Oceanview Road

Key facts:

- Only less than 1/8 rain water drains from the top end of the road to the point of culvert at the 270 driveway.
- That volume of water at the tunnel was documented and photographed including comparison to very similar conditions at lover Kevin Grove street which handles a multiple times greater volume with no problems. This information was submitted to the village office in March 2016. See the attached file.
- The water coming down Oceanview Road to the north of 270 property, going under the road and around the corner, continues to seep into the ground along the road between 260 and 180, despite the fact that the Village placed a large pipe there for a considerable section.
- There is no practical way to properly measure the water flow along Oceanview Road because mid-section has a ditch covered by a black pipe, which prevails assessing the flow volume since water flow under the pipe, and lower portion of Oceanview Road sides were totally filled with dirt. That distractive action was taken based on solicited decision by a superintendent over 20 years ago. That was also a reason for the recent problem in the lower road area last year. It should be noted that the repair, resolved nearly nothing as demonstrated by the need for additional expenses today; a typical short-term momentary fix.
- On rainy days, most of water flows on the asphalt surface from the area of junction with Oceanview Place all the way to the bridge.

We must <u>not repeat the previous mistakes</u> and not settle for <u>another meaningless / temporary fix</u>.

The proper solution for the Oceanview Road and considerably easier project is to provide water drainage using open half pipe bedding:

- along the entire road to the north of 270 in the existing trench and
- all the way from the existing culvert /tunnel under the road next to 270 driveway down to the Harvey Creek.

The Village already has a large diameter black pipe resting in a trench north of 260 Oceanview and more in storage. This pipe can be cut / sliced in half along its length, then placed properly along total distance of the road between the individual culverts over the driveways.

In our specific environment, for the proper rain water drainage and maintenance along the street, we must have open channels 90% of the way, allowing only closed culvert sections under the driveways.

A small excavator owned by the Village can do all that work adequately since the trench is already in existence most of the way and it is very easy to get at from the road.

That is a simple and inexpensive solution good for the next 50 years.

When comparing true costs of the latest proposed alternative immediate solutions between:

A. Digging through the 260/270 easement
B. Improving drainage between 245 down to the junction with Highview Place

Option B if conducted using already available, sliced in half large diameter plastic pipe properly placed in the existing channel, is by far less expensive. The realistic cost is $10-20K.

Here are some historical facts that deserve your attention.

Reason 3 Social aspect - handling residents with respect and fairness

Owners on 260 property were more than improperly treated by the village of LB through the course of purchasing the property and afterwards. In short:

- Selling a property by the village with improper easement registration – later corrected by the owner with benefit to the village and loss to the owner.
- Selling a building property without opportunity for a sewage field and a household existence.
- Imposing a necessity to build a sewage line to Kevin Grove treatment plant and doubling the original cost of the property.
- Knowingly leaving the 250 owners' driveway on 260 property and creating incredible hardship for all and difficult relations that last to this day.
- Refusing to clear reoccurring blockage by debris and ice in the water drainage culvert.
- Refusing for a long time to deal with the old, rusted and seriously leaking culvert that resulted in flooding of our basement and destroying our house parameter rain water drainage system.

After changes to water drainage route were imposed by the village, the municipality filled the large void in front of our house with debris (rocks, broken asphalt, soil) and advised of no future village use of the area. At that time the owners of 260 property were advised, and in practical aspect forced, to spent substantial effort and money on cleaning and beautifying the area.

What we really need is a new asphalt surface on the Oceanview Road that was in village plans 35 years ago.

March 3, 2016 at 12.30pm after very strong rain for two days – photos taken from the same height of camera

Oceanview Road between 245 and 260/270

Along Tidewater Way at Sweetwater Place junction – same layout as Oceanview, but 3 times water volume

LIONS BAY INFRASTRUCTURE COMMITTEE MEETING
MONDAY 26 NOVEMBER 2018 AT 7:00 PM
COUNCIL CHAMBERS, 400 CENTER ROAD, LIONS BAY

MINUTES OF THE MEETING

In Attendance:

Fred Bain – Councilor and Committee Chair
Norm Barmeir - Councilor
Neville Abbott – Councilor
Ron McLaughlin - Mayor
Naizam Jaffer – Public Works Manager
Jim Mutrie – Resident
Tony Greville – Resident
Karl Buhr – Resident
Brian Ulrich – Resident

Regrets:

Peter Dejong - CAO

1. **Call to Order**
   Meeting was called to order at 7:03 pm.

2. **Appointment of Recorder**
   Brian Ulrich was appointed Recorder.

3. **Approval of the Agenda**
   The Agenda was approved as is.

4. **Public Questions & Comments**
   None

5. **Approval of the Minutes**
   A. The 24 September 2018 IC meeting minutes were approved with the following changes:
      - In Section 3, grammar in second sentence was corrected to read: ‘The order of Sections 7 and 8 of the agenda was reversed so Section 8 was discussed first.’

      - In Section 8 C, all instances of ‘Rundel’ were changed to the correct spelling of ‘Rundle’.

   B. Review of Action items from 24 Sept 2018 minutes.

      Action item in section 8E: Staff to update the peak power demand for both buildings for comparison with the generator capacity. Not complete – Carry forward.

OPEN ACTION: Staff to update the peak power demand for both buildings for comparison with the generator capacity.

6. **Business Arising from the Minutes**
   No business arising from the minutes.

7. **Unfinished Business**

   A. Grant Funding Opportunities.
   Since the CWWF grant scope was scaled back to include only a new Harvey tank, the Highway tank and PRV compliance upgrades that were in the original application are now still not addressed and therefore seeking opportunities for grant funding.

   B. Investing in Canada Infrastructure Program (ICIP).
   Phase 4&5 tank(s) demolition, Bayview PRV, and Mountain Drive control valve are included in the application for the ICIP grant. Urban Systems wrote the application for us and the application has been submitted. We are currently waiting for approval.

   C. Community Culture & Recreation Infrastructure (CCRI).
   Committee and public consultations are complete and Staff has been directed to prepare an application for funding of the Beach Park revitalization project under the CCRI grant.

   D. Oceanview Stormwater System
   In the last IC meeting the Committee recommended that Council direct Staff to determine how far the concrete plug extended into the abandoned culvert from Oceanview to Rundle Creek. This activity was carried out and Nai presented the results together with a 2008 Golder Associates report on the drainage in this area.

   A full cement truck load of concrete was ordered to fill the abandoned drainage channels. The culvert under the driveway at 270 Oceanview Rd was completely filled and the remainder of the truckload of concrete was pumped into the abandoned culvert to Rundle Creek (under the easement between 270 and 260 Oceanview). It is still not known exactly how far the concrete extends into the easement culvert but it must be a long way since the remainder of a truckload after filling the 270 driveway culvert is still a significant amount of concrete. The conclusion is that there is too much concrete to hammer out in order to reline the culvert so that proposed solution is no longer deemed a viable option.

   The options identified at last meeting were:
   Option A: Re-establish original drainage path to Rundle Creek.
   Option B: Maintain current drainage path all the way down to lower Oceanview.

   Option A was, at the last meeting, considered the ‘technically right’ thing to do notwithstanding cost. Now that it is essentially confirmed that the least cost solution to Option A (relining the culvert) is eliminated, only the higher cost directional drilling

or open excavation solutions remain. The pro's and con's of these solutions were discussed at length.
Option B was, at the last meeting, considered more of a band aid solution. It includes addressing the infiltration in the swale under the big (ugly) black pipe and upgrading the drainage ditch and all the undersized driveway culverts to handle the increased flow all the way down Oceanview to Harvey Creek. In this meeting Option B seemed to be attractive to several IC members since it solves the current issues along lower Oceanview (infiltration to properties, road damage, culverts & ditch capacity). These issues may or may not still exist if the flow were reduced by implementing Option A and diverting significant volume to Rundle.

The map shows that the Option A distance from 260 Oceanview to Rundle is very much shorter than the Option B distance from 260 all the way down to Harvey Creek. This prompted the question as to whether Option B is really more expensive than Option A. Specifically, is drilling or trenching the short distance really more expensive than excavating/replacing 10 or 11 driveways/culverts, and excavating/geo-lining the entire length of lower Oceanview ditch?

A previous estimate to do Option B was around $300K, without any detailed drainage calculations or detailed design. It is not known how much it would cost to directional drill or excavate to Rundle. Nor is it known how much the flow down lower Oceanview would be reduced if upper flow is re-established to Rundle.

Nai indicated that a study to determine the flows, designs and costs for both options would cost $15K to $18K. This would help us understand the resulting stormwater flows in each option, and provide accurate costs for directional drilling, and open excavating for Option A and a scope review and refinement of the previous cost estimate for Option B. Given the potential to make a poor decision that future Councils would have to deal with, the IC agreed that it is worth spending the money on this study.

RECOMMEMDATION: The IC recommends that Council direct staff to commission the study to assess the resulting drainage flow scenarios for Option A and Option B and to provide cost estimates for both options. Cost estimates for Option A should include costs for both directional drilling and open trenching alternatives and the challenges associated with each.

8. **New Business**

A. Updated Terms of Reference (as adopted by Council, November 20, 2018)
Minor changes were discussed to the TOR and Fred will submit the revised version to Council. The major change was to composition. The wording to be changed to allow equal numbers of councilors and residents on the committee instead of the current 3 and 3.

Karl proposed changing the dates of IC meetings; currently the 4th Monday of every month – specified in the TOR. However the Committee Chair has the authority to call

meetings at different times as required and it was agreed that Fred would schedule all meetings on the 4th Thursday of January, February, March and April in 2019 and all remaining 2019 meetings revert back to the 4th Monday of each month.

ACTION: Fred to reschedule the first 4 IC meetings in 2019 for the 4th Thursday of each month.

9. **Public Questions and Comments**
   None.

10. **Closed Infrastructure Committee Meeting**
    The Closed Meeting Agenda was followed and regular open IC meeting was resumed upon conclusion.

11. **Adjournment**
    Meeting was adjourned at 8:46 pm.

12. **Next Meeting**
    There will be no meeting in December, 2018.

Current Status

Public Works staff were able to partially repair the wastewater treatment plant (WWTP) late yesterday afternoon. The plant is **not** fully functional but is operating between 80 to 90 percent of its capabilities. A short video showing the motor turning the media disk can be viewed on YouTube. For more information on the plant and how it functions see the 2018 Annual Report available in the Reports and Documents section of our website.

The Municipality would like to thank you for assisting us in minimizing the wastewater discharge to the environment.

Next Steps

On February 28, 2019 at 7:00 PM, in the new upper Council Chambers, staff will present information to the Infrastructure Committee about the recent failure of mechanical components of the Kelvin Grove wastewater treatment plant (WWTP). Staff will also provide the Committee with the:

- reporting requirements to the Environmental Protection Officer responsible for the WWTP;
- current condition of the plant;
- status of temporary repairs;
- sourcing of replacement parts to repair the plant; and
- future repair and replacement methodology

As with all Infrastructure Committee Meetings, this meeting is open to the public and residents may address the Committee for up to 2 minutes during the Public Questions and Comments portion at the end of the meeting.

Staff, the Infrastructure Committee, and Council encourage those interested in learning more about the current WWTP issues to attend the meeting.

KELVIN GROVE SEWER TREATMENT PLANT CAPACITY DIMINISHED

On February 4, 2019 staff discovered a mechanical failure at the Kelvin Grove sewer treatment plant and were forced to turn the plant off. Various parts were sourced as quickly as possible to get it back up and running. Unfortunately, the rotor disks can no longer be purchased and a complete unit will need to be fabricated from scratch meaning it will likely be some time before the damaged rotor disks can be replaced. This has resulted in diminished capacity to treat wastewater before it enters the waters of the Kelvin Grove Beach and Marine Park. During the course of the break-down, the plant will be not be treating wastewater to its full capabilities and as required by the Ministry of Environment, staff will be sampling and reporting on the effluent quality on a weekly basis.

Residents of Kelvin Grove are being asked to help minimize the amount of wastewater entering the plant and flowing through to the ocean until the plant has been fully repaired. Some tips to help you help us and our environment include:

- Keep showers to a minimum;
- Only do full loads of laundry when necessary to minimize discharge;
- Only run your dishwasher with a full load;
- Turn off the tap while brushing teeth or washing hands;
- If it's yellow, let it mellow; if it’s brown, flush it down.

We thank you for your assistance during this time and will keep you posted on repairs via the Village Update. This incident has also highlighted the fact that the plant is nearing its estimated end of useful life and that we need to plan for its eventual replacement.

KELVIN GROVE WASTEWATER TREATMENT PLANT REPLACEMENT FAQs

1. **What is the Kelvin Grove Wastewater Treatment Plant (WWTP)?**
   The WWTP, located at the foot of Tidewater Way in Kelvin Grove Beach Park, is the facility that treats all sewage from homes located in upper and lower Kelvin Grove. It was built by the developer circa 1981 when the neighbourhood was created.

2. **Why does the Kelvin Grove WWTP need to be replaced? Can’t it just be repaired?**
   All infrastructure has a useful lifespan before it must be replaced and many things affect that lifespan, including ongoing maintenance and repairs. The Kelvin Grove WWTP has seen

many minor and major repairs over the years as various parts of the plant fail. Eventually, repairs become unfeasible due to financial impracticality or non-existent parts, or both. As well, the regulatory environment dictated by higher orders of government changes and treatment requirements become stricter. The Public Works department will continue to maintain and repair the facility as long as possible, but ultimately, the need for replacement is on the horizon.

3. **Does the WWTP treat sewage from other neighbourhoods as well?**
   No, upper and lower Kelvin Grove are the only neighbourhoods in Lions Bay that are connected to a sewage treatment facility. All other lots in Lions Bay (other than one on Oceanview Drive connected to the Kelvin Grove system) have private septic systems for which the property owner is responsible. These too require maintenance, including regular emptying of tanks by pumping contractors (about $1,000 annually for these things), and have a defined life expectancy (about 30-40 years) before they have to be replaced at the substantial expense of the property owner (about $30-40K or more). Kelvin Grove residents do not contribute to these septic system costs.

4. **Does the rest of the Village contribute to the costs of the WWTP? If not, why not?**
   No, the rest of the Village does not contribute to the costs of the WWTP because they do not benefit from the service at all, just as Kelvin Grove property owners do not benefit from nor contribute financially to septic systems throughout the rest of the Village. This is not the same as the provision of services for water, roads, drainage, parks and other services that are shared by all and paid for by all regardless of which neighbourhood they're located in (eg: 2011 Kelvin Grove watermain emergency repair of $327K paid for by all property owners as a cost of the water service).

5. **How is the current sewer utility fee calculated? Does it account for suites?**
   The current sewer utility fee is based on the costs to operate the system divided by the number of properties connected to the system. It is not based on the number of persons per household. Owners with secondary suites in all neighbourhoods are charged separately under the secondary suite surcharge bylaw. A proportionate share of that revenue is included in the sewer budget to help reduce the net fee required to fund the service.

6. **How is it that long term planning for the replacement of the WWTP facility wasn't undertaken ages ago so that Kelvin Grove property owners wouldn't be faced with having to fund a major cost in a short time frame?**
   That's a good question and one that has been asked in cities and towns across Canada as people begin to understand the ramifications of the infrastructure deficit that has been

accumulated by almost all communities. Local governments have been good at covering operational costs but not so good at saving for capital replacement costs. In this regard, Lions Bay is no different than most others in respect of the lifecycle costs of all its infrastructure, as noted in the Infrastructure Master Plan and the new Asset Management Investment Plan, which was presented to the public at the Council Strategy Committee meeting on Thursday evening, February 7th. The last Council set out to identify and address our infrastructure deficit and the current Council is continuing that work. This affects all Lions Bayers and it will take diligent work for many, many years to achieve a sustainable community.

7. **What financing options besides parcel taxes on Kelvin Grove residents have been or will be considered for replacement of the WWTP?**
   All financing options to replace the WWTP will be explored, but each comes with its own set of issues that Council will have to weigh and consider. These include:

   a. **local service area tax** – requires 50% approval from affected property owners, who may be taxed in the form of a parcel tax or property tax;

   b. **parcel taxes on Kelvin Grove property owners** – this is the standard methodology used to pay the capital costs of infrastructure related to local service areas (i.e. Kelvin Grove);

   c. **parcel taxes on *all* Lions Bay property owners** – this would require a commitment to sewer the entire Village over a specified length of time (eg: 30 years) but is an option that may become clearer after the WWTP replacement study;

   d. **borrowing funds to finance the upfront capital costs of replacement over a long period of time (eg: 30 years)** – this is very difficult when the service for which the funds are being borrowed is not a service which is shared by most of the Village as the overall borrowing limit of the Municipality is affected and is already at or near a prudent percentage of borrowing capacity (i.e. about 60%), although this will have decreased in 5 years, assuming no new, unaccounted for borrowing in the interim,;

   e. **grants to help cover the capital costs of replacing the WWTP** – this will certainly be explored to the extent there are grants devoted to the replacement of sewage treatment infrastructure, as opposed to grants covering a variety of eligible categories affecting services benefiting all of Lions Bay (the Municipal portion would still need to be financed by the users benefiting from the service currently or in the future);

f. **development of properties which would connect to the sewer system** – the WWTP is currently operating at about 90% of design capacity, meaning that any substantive new development would have to contribute to the costs of increasing that capacity, with potential contributing sites including the following:

   i. 175/185 Kelvin Grove Way – a preliminary development proposal was presented to Council in 2018 by the owners of these two lots, which are noted on the OCP as "Potential Development", but the presentation was not well received by the Kelvin Grove property owners who attended that meeting;

   ii. 89 Tidewater Way – the owner has been in preliminary discussions with staff about the potential for a subdivision application on this large lot, in accordance with the opportunities provided through the new zoning bylaw adopted in 2017;

   iii. 5 Tidewater Way – staff are preparing an application for a Crown Lease on Brunswick Hill to enable the Public Works Yard to move from its current location, thereby freeing up the opportunity to develop the current site, noted on the OCP as "Potential Development" and which would be connected to the WWTP;

   iv. 410 Crosscreek Road – the two residential stratas and the commercial / residential strata have been undergoing a review process to determine the feasibility of redeveloping the lands on which the condominiums and the store / cafe are situated and if this were to proceed, the Municipality would require connection to the WWTP;

g. **using the net sale proceeds from the new lot at 35 Kelvin Grove Way to defray the replacement costs of the WWTP** – while this single lot connection will not materially affect the current capacity of the WWTP, once connected the prospective new owner will contribute to the capital and operational costs of the service the same as any other Kelvin Grove property owner, but net sale proceeds were intended to help replenish the Municipality's general reserves (development costs to date of about $150K have not been charged to Kelvin Grove taxpayers, but rather shared by all Lions Bay taxpayers, similar to the sharing of benefits and costs in respect of the new lot for sale at 52 Brunswick Beach Road).

8. Why will the WWTP replacement study be charged to the sewer budget reserve instead of being shared by all Lions Bay property owners?

The primary purpose of the WWTP replacement study will be to address the replacement of the current facility to meet modern regulatory treatment requirements, but the potential for an incrementally expandable modular plant capable of servicing a larger number of users over a long period of time (i.e. the potential for a phased expansion of the plant's capacity) will be an added component of the study, which would ultimately be of benefit to the existing users of the service (eg: the more users available to share the costs the lower the individual costs will be) – a feasibility study for a phased expansion of sewer infrastructure (eg: pipes and pump stations throughout the rest of the Village) would logically be a cost shared by the rest of the Village.

9. Why are we only hearing about the need to replace the WWTP now?

As noted in the answer to question 6, the last Council (and staff) expended significant effort to produce an Infrastructure Master Plan. That document was heralded as an important piece of the Municipality's long-range infrastructure planning and it includes a section on sewage treatment infrastructure. It was communicated through the Village Update and it lives on the Municipality's website on the Reports and Documents page. The need to plan for that infrastructure was also noted in the 2016 Annual Report and Council's Strategic Plan. Planning for the replacement of *all* Village assets is the objective of the new Asset Management Investment Plan, which will also live on the Reports and Documents page when the draft Plan has been finalized and received by Council soon. Recent mechanical malfunctions at the WWTP turned a spotlight on this asset and the need to prepare for its eventual replacement.

10. Why can't we just keep repairing the existing sewage treatment plant?

As noted in the answer to question 2, we will continue to maintain and repair the facility as long as possible, but the plant is aging and mechanical components are deteriorating. As these components wear out or fail, *they have, are, and will continue to be replaced* – we've already replaced the chain and sprocket twice, the motor once, the serpentine coupler 3 times, the gear reducer twice, the chain-oil drive twice, the media packs once each so far, etc... Our intent is to continue to repair the plant as long as is feasible and parts are available. The current mechanical failure is due to rusting of one of the media pack supports on the axel housing media packs 1 & 2. This support wore thin and snapped with a portion of the support jamming into the side of the plant and effectively putting the brakes on the rotation. Media packs 1 & 2 were replaced in 2002 giving it a 16-year +/- lifespan. Disks 3 & 4 were installed in 2010; therefore, anticipating a 16 +/- lifespan, we can expect these to fail in 2026ish.

Replacement of the plant is an eventuality, likely sometime within the next 5 – 8 years (or longer). This fact is driven by several issues:

(a) This is a proprietary packaged treatment plant subject to patents owned by the RotorDisk brand. The mechanical components are becoming harder to obtain and, as is the case with the chain and sprocket, have to be manufactured as one-offs. The sprocket is not a standard unit that can be purchased off-the-shelf at a marine or mechanical outfitter, it's a specialty item for which the manufacturer's representative in Ottawa had to have custom fabricated at their metal shop using the RotorDisk custom design. At some point in the future, replacement parts may not be available and we'd be faced with attempting to jerry-rig parts to make the plant function.

(b) The plant was designed for a maximum effluent volume of 218 m^3/day based on the number of lots in Kelvin Grove, some of which have not yet been developed. Last year, we approached 200 m^3/day on two occasions; incoming wastewater volumes beyond this number will result in a reduced treatment ability and will likely put us out of compliance with the bacterial and suspended solids (BOD and TSS) counts allowed under our permit.

(c) According to the Environmental Protection Officers and Ministry officials we have had discussion with, any major upgrades (like complete replacement of the internal components of our plant with a similar but new RBC system), decline in treatment performance, or increases in effluent volume, will trigger a new registration process via the Municipal Wastewater Regulations. Registration would subject us to the current standards for treatment of wastewater with caveats for upgrading these requirements to include personal care products (PCPs) and contaminants of emerging concern (CECs). New permits will include more stringent BOD/TSS values and nutrient removal along with tertiary disinfection through chlorine or UV treatment.

Among other things, the study being proposed will determine the appropriate technology required to meet current and potential treatment requirements along with the potential for building out the wastewater system (in phases if possible) to meet the needs of the whole Village, or a greater portion of it, which would result in a wider sharing of associated costs.

11. Has the engineering study for replacement of the WWTP been commenced? What is the anticipated time frame for delivery of the study? Has the Village has been able to access any grants to offset the cost of the study?

Staff are exploring grant opportunities to offset the cost of the study and are in the process of determining the scope of work for the engineering study; this work will dovetail into the process of preparing a Request for Proposals (RFP) that will be posted to BC Bid, a marketplace where public sector organizations (including local governments, school districts, health authorities, Crown corporations and the B.C. government) advertise opportunities for contracts for a wide range of goods and services. Once posted, it will be

open for about 3 weeks. Staff will then bring a report to Council with a recommendation for awarding a contract for the study. Staff anticipate the study itself will likely take a couple of months before a final report is received.

12. **Once the engineering study is received, how long will it be before a decision can be made on how to move forward, one year, two years, more, less?**

    Once the study is received, it will be reviewed by staff and the Infrastructure Committee and a recommendation on how to move forward will be brought to Council. At that time, likely July, long term financing options and a replacement schedule will be revisited.

13. **With the length of time it appears to take to get new parts, and given the number of years before replacement of the WWTP would actually happen, would it be prudent to have a few of these parts on hand, particularly for vital items, notwithstanding the expense?**

    Many of the components are no longer available and need to be manufactured specifically for each order. For the most part, staff closely monitor the components of the plant for corrosion and potential failure. The most recent component that failed was an internal component of the media packs that was not readily visible at the time of inspection. Some components can be purchased and manufactured ahead of time; however, a cost/benefit and risk analysis of this option will indeed be explored further once the current set of repairs has been completed and all repair costs have been finalized.

14. **The Infrastructure Master Plan of 2016 indicated that safety repairs of the WWTP should be performed as soon as possible to reduce workplace risk. Has that been done?**

    Yes, these repairs involved the replacement of deteriorating wooden walkways and handrails with aluminum, a new bridge over the secondary clarifier, and the construction of new doors to the plant. This project was completed in late September of 2016 at a total cost of $20,758.

15. **The existing WWTP system was likely designed and built to accommodate as many single family homes as there are lots in KG. If an expandable WWTP was considered to be an option then presumably there would be an additional encroachment into the Kelvin Grove Park area to accommodate any expansion. Is this correct?**

    Many new treatment plants are quite compact and modular but the available footprint at Kelvin Grove Park will certainly be considered with respect to all potential options.

16. **How many more connections could be realistically accommodated with an expanded WWTP? I would not think that an expanded WWTP would be able to provide sewer services for the whole Village, or could it?**

    Yes, a modular WWTP could be expanded in phases to service the entire Village.

17. **The Infrastructure Master Plan at 3.1.2, Table 3-1 indicates a replacement value for the existing WWTP of about $1,300,000. 3.5.3 indicates the estimated costs of a proposed expanded sewer system for the entire Village would be around $15,557,200 and for an upgraded WWTP alone the cost as shown in Table 3-2 would be in the region of $4,000,000 which is twice the cost of the estimated replacement cost noted in the Direction Request of January 30, 2019 of about $2,000,000. I assume the price differential is because the concept for sewer services for the whole of the Village takes into consideration an expanded WWTP. Is this correct?**

    Yes.

18. **As noted in the Direction Request, the financing of a replacement WWTP will be an expensive exercise and has a number of challenges. The Village cannot take on any further borrowing since it is currently at 60% borrowing capacity. If all else fails and no additional grants or funding can be found the funding for this infrastructure project would be downloaded onto those current residents who have the benefit of the use of the sewer system. Development cannot be relied upon to contribute to the costs if no development takes place for years and at this stage any development can only be considered as a potential not a certainty. As I understand it, the idea is the cost of the project would be borne by each residence contributing what might be close to $5,000 per year for a period of 5 years. Given that the WWTP now appears to have risen in priority as an infrastructure project does the Council or the Committee know how much money would be required upfront before commencing the project?**

    The engineering study is being financed by funds within the sewer reserve. This study will provide guidance on treatment requirements and options, along with some estimated costs. Even with a reasonably good scenario whereby WWTP replacement costs are low and a 2/3 grant is available, Kelvin Grove residents would still need to fund about $1,000/year for about 5 years or so, based on an expectation that the plant will need to be replaced in 6-8 years and the assumptions set out above.

19. **If it was decided that it would be preferable to go for an expandable WWTP so that at**

some future point in time other residents in the Village could gain access to the sewer system would the current owners of the properties in KG (presumably including vacant lot owners and the property on Oceanview) have to pay all the upfront costs for an expandable WWTP? An expandable WWTP appears as if it would be quite bit more expensive than a replacement WWTP. Is that a correct assumption?

It depends upon the treatment methodology selected for the WWTP. Current membrane technology has led to very compact wastewater treatment systems that can be modularly expanded to increase treatment capabilities. The intent would be to construct a new facility that could be expanded as required to incorporate additional neighborhoods as a phased approach. Any costs related to actual expansion of the WWTP would logically be borne by those benefitting parcels, but the base capacity for an expandable plant will not necessarily be much more expensive than the base capacity for a non-expandable plant.

20. **Due to costs I assume that any expansion of sewer services within the Village would have to be done in phases. That being the case, the benefits of reduced sewer fund costs coming back to those who have funded an expandable WWTP project might not necessarily materialize for years, if not decades. If that were the case, please explain why a more expensive expandable WWPT would be a good option at this time without other residents in Village (who might have the opportunity to attach to the WWPT within a reasonable time frame in the future) joining in to help fund it?**

    This question is based on an incorrect premise that an expandable WWTP is necessarily more expensive or that Kelvin Grove residents would be paying a premium for an expandability option. Any incremental costs of expandability ought to be identified for fair and appropriate resolution and any actual costs of expansion ought to be borne by those parcels benefitting from the expansion.

21. **How can residents and property owners receive more information and provide feedback?**
    Mayor and Council want to ensure that all residents are aware of these matters as they evolve and come before Council, transparently sharing information and receiving feedback. Our primary means of communication is the Village Update, so if you are not yet a subscriber, you are encouraged to sign up here. If you wish to explicitly have your personal correspondence included on the next regular Council meeting agenda, click here.

    If you wish to provide feedback to Council and staff, or ask additional questions, please use the feedback form on the website here, or email feedback@lionsbay.ca – staff will add new questions and answers to this page for the benefit of all to review.

THE VILLAGE OF LIONS BAY

KELVIN GROVE

Wastewater Treatment Plant

2018 ANNUAL REPORT

JAN
2019

Naizam Jaffer
Public Works Manager

CONTENTS

Introduction

The upper and lower Kelvin Grove neighbourhoods in the Village of Lions Bay are serviced by a sanitary sewer network that culminates in a wastewater treatment plant (WWTP) that was constructed in 1981 on the waterfront of Howe Sound, at the Kelvin Grove Beach Park. A total of 94 residential lots are connected to the WWTP through a network of 2,173 meters of 200mm PVC sanitary sewer pipes, manholes, and property connections or service laterals. A map of this sanitary sewer system is shown in Appendix 1.

TREATMENT AND MICROBIOLOGY

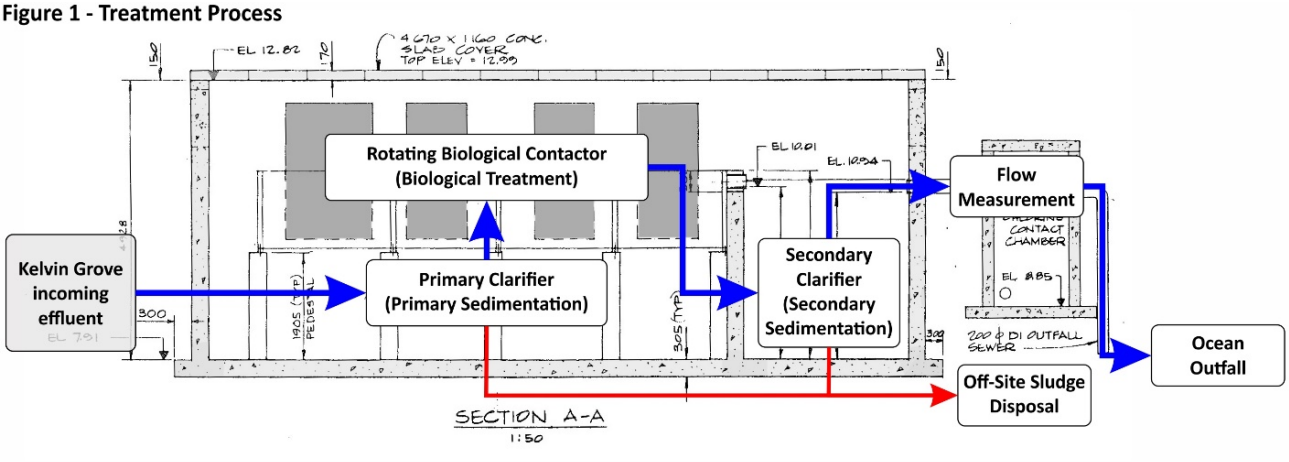
The Kelvin Grove WWTP is a fixed-film treatment process that consists of three distinct process phases:

- Primary Sedimentation;
- Biological Treatment; and
- Secondary Sedimentation.

Upon passing through each of these phases, the treated wastewater passes through a flow measurement device consisting of a weir and level transducer mounted within a metering chamber. Once through the flow meter, the wastewater is released into Howe Sound via an ocean outfall pipe 85 meters beyond the high tide mark and at a depth of 60 metres.

The treatment process is represented diagrammatically below:

Figure 1 - Treatment Process



The wastewater treatment process is dependent upon the presence and activity of the microorganisms within the wastewater and treatment plant. This microbial ecology is a complex combination of interrelationships among bacteria, protozoa, and metazoa with the organic contents of the wastewater. Microorganisms use this organic content as a carbon source for respiration, energy generation, and biomass production. Once the organic content of wastewater is depleted, microorganisms form floc and settle out of the wastewater stream as sludge.

PRIMARY SEDIMENTATION

Wastewater enters the primary clarifier or primary sedimentation tank where suspended solids are removed by gravity sedimentation under quiescent conditions. The settled solids form a sludge blanket at the bottom of the clarifier. The primary clarifier also provides for effective removal of grit, debris, and excessive fats, oils or grease (dubbed 'FOG') prior to the supernatant's entry into the biological treatment phase.

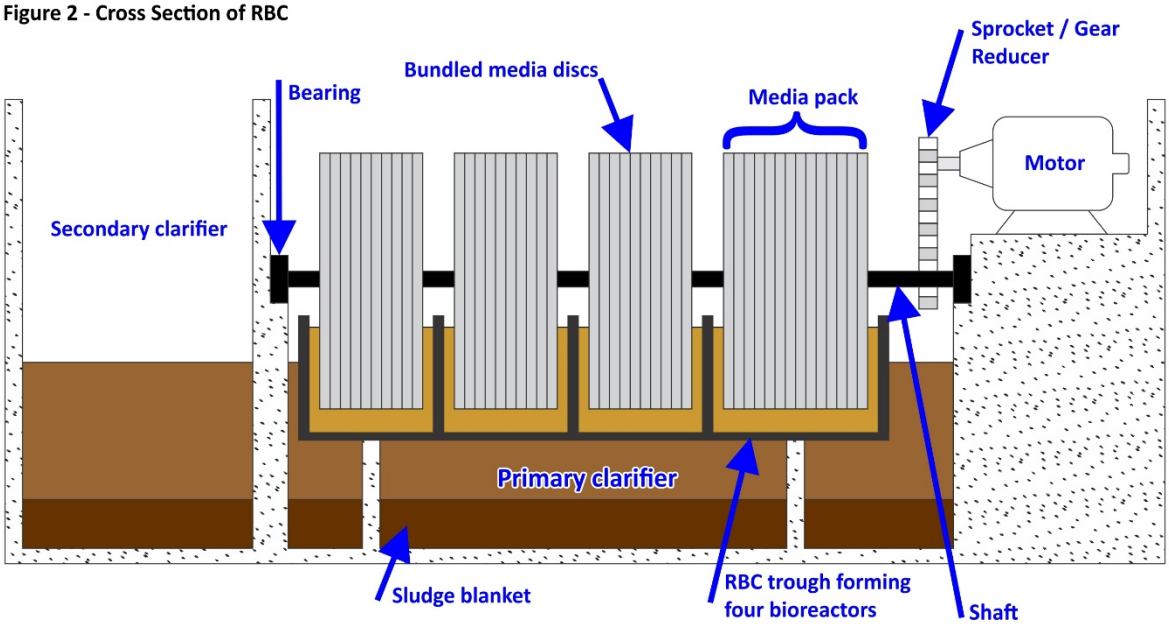
Continual input of raw wastewater into the primary clarifier and gravity settlement results in a thickening of the sludge blanket over time. Sludge blanket depth is a crucial component to the proper functioning of the treatment system, so much so that at excessive sludge blanket depths (greater than 30 cm) the sludge may turn septic, which depletes oxygen levels that ultimately inhibits healthy biomass growth which thereby decreases treatment efficiency.

BIOLOGICAL TREATMENT

From the primary clarifier, the supernatant with its colloidal and dissolved organic matter is further cleansed by biological treatment which is accomplished by a rotating biological contactor (RBC) treatment system. The RBC consists of multiple large diameter, closely spaced corrugated discs constructed of high-density polyethylene (HDPE). These disks are bundled together into what is termed a 'media pack' and are mounted in series along a horizontal shaft [Figure 2]. The Kelvin Grove WWTP utilizes the L400 ROTORdisks™ system, which has four media packs separated by baffles into a series of bioreactors, each referred to as a stage. An electric motor rotates the shaft and media packs at a rate of 1.5 to 1.6 revolutions per minute, alternately exposing the media packs to wastewater and air. Microfauna within the wastewater affix themselves to the discs creating a biofilm over the entire surface area of the media. The corrugations on the media disks are designed to give extra surface area per unit volume to each disc thereby increasing the biofilms ability to metabolize and treat the organic materials contained in the wastewater. This permits high degrees of treatment to be achieved for relatively short wastewater retention times.

Photo: Initial biofilm growth on RBC media.

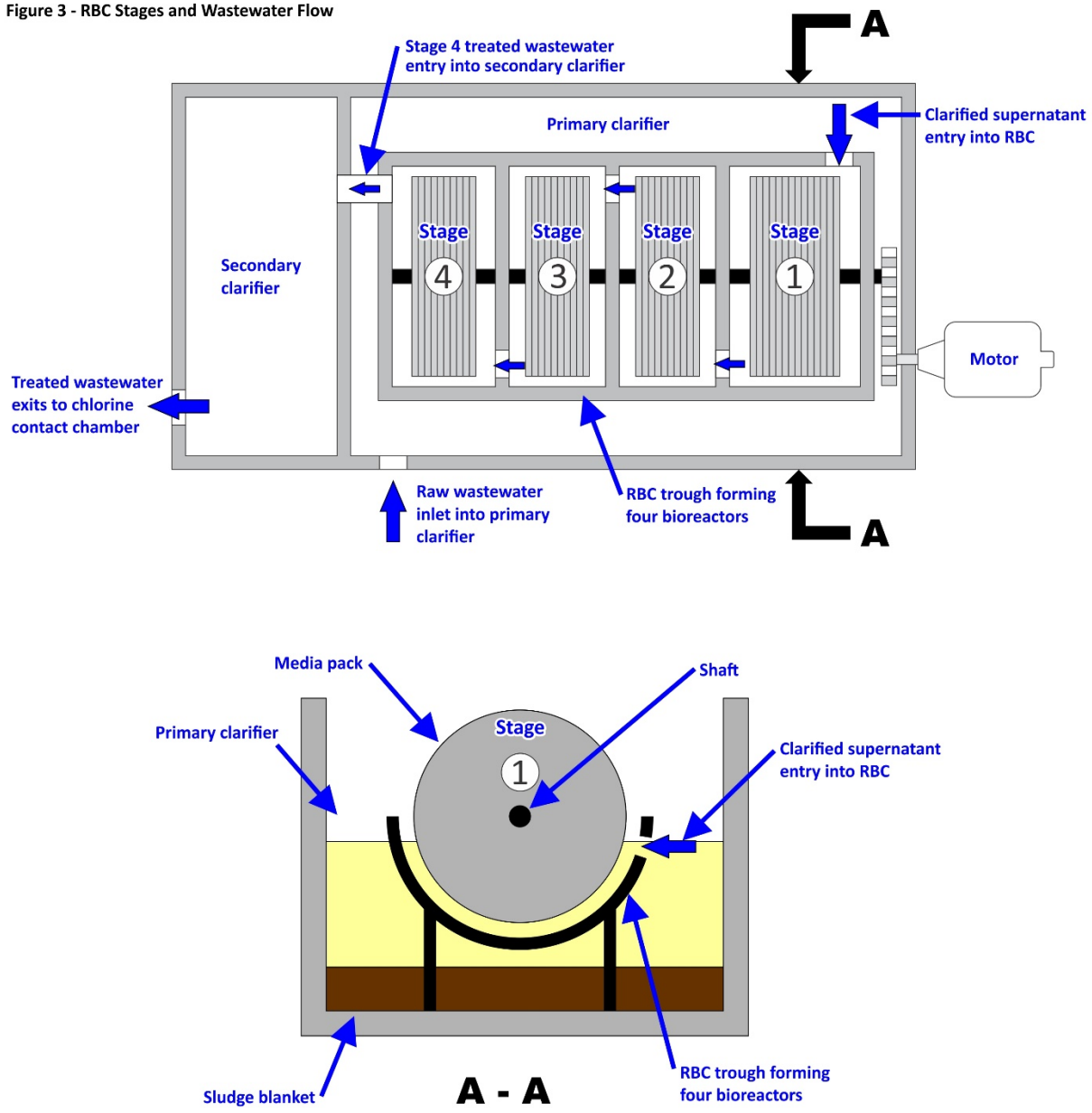
Figure 2 - Cross Section of RBC



From start to finish, the wastewater flows through the RBC's stages or bioreactors by simple displacement and gravity. As wastewater passes from stage to stage, it undergoes a progressively increasing degree of treatment by specific biological cultures in each stage, which are adapted to the changing wastewater.

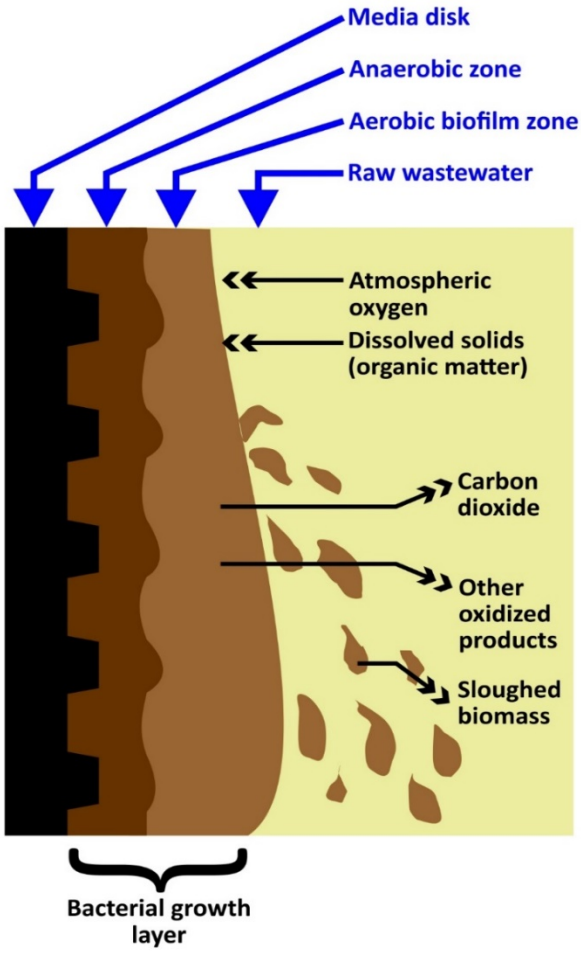
The supernatant enters the first bioreactor (Stage 1) at the point furthest away from the inlet to the plant [Figure 3]. This is the stage where the highest biological activity occurs and where biofilm accumulations are the greatest since the organic loading is highest. As the biofilm thickens, it develops into two layers: an active (aerobic) and an inactive (anaerobic) layer. By and large organics within the wastewater are transformed into biomass in the aerobic layer.

Figure 3 - RBC Stages and Wastewater Flow



Biofilm growth increases on the media disks until it reaches a tipping point with the continual drag caused by the media packs rotation generating shearing forces that causes excess biomass to slough off into the supernatant [Figure 4]. Rotation of the media also provides turbulence at the interface between biomass and wastewater so that dissolved oxygen and wastewater nutrients to the biomass through the mechanism of mixing and that of diffusion. This continual rotation also serves to keep the sloughed material in suspension through the progressive stages and into the secondary clarifier.

Figure 4 - Cross Section at RBC



Microfauna in the Initial stages are almost entirely constituted by species of ciliates and filamentous and nonfilamentous bacteria. As the wastewater passes through subsequent stages, it undergoes a progressively increasing degree of treatment by specific microfauna in each stage. The decreasing concentration of organic matter leads to the appearance of higher life forms including nitrifying bacteria, along with various types of protozoans, rotifers, and other predators.

In a well-functioning unit with the appropriate feed rate, nutrient loading, microfauna, and media rotation rates, the RBC will emit an earthy, humus-like ("musty") smell inside the unit. A substantial sour or "sewage" smell is indicative of suboptimal conditions.

SECONDARY SEDIMENTATION

Once through the fourth stage of the RBC, the treated wastewater enters the secondary clarifier. The large aggregates of biomass sloughed off the media packs retain their high density and settle rapidly in the secondary clarifier. At this point in the process the effluent is relatively clear and colourless and free of suspended matter. Sludge from the primary and secondary clarifiers is removed on an annual basis and transferred to the Iona Island wastewater treatment plant in Richmond where it undergoes further treatment.

KELVIN GROVE WWTP OPERATING PERMIT

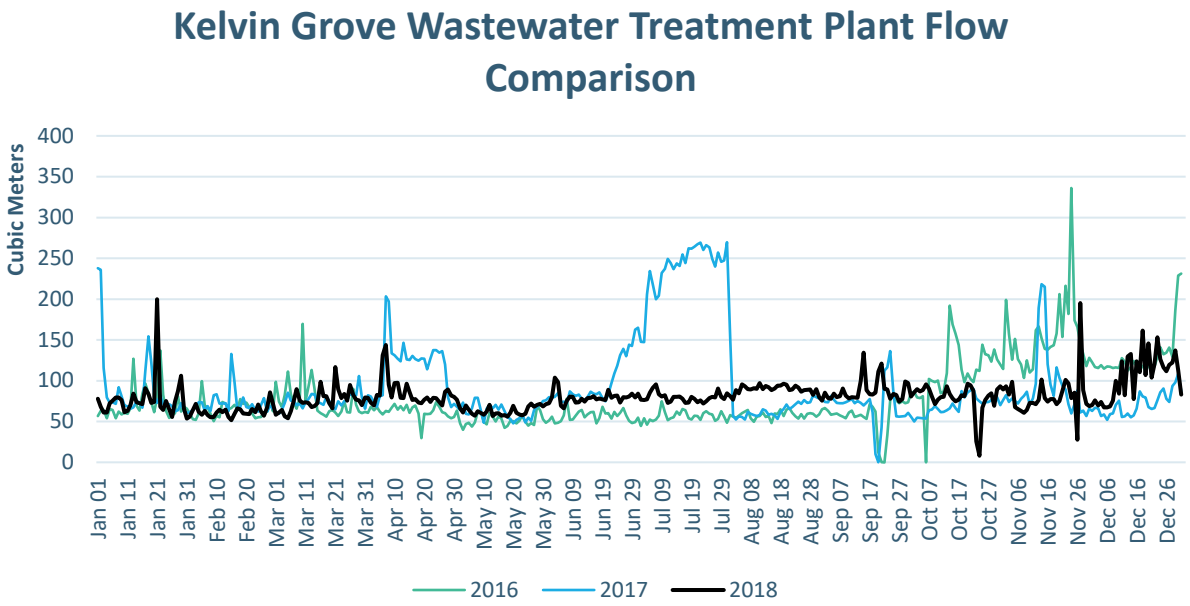
The authority to discharge wastewater into the waters of Howe Sound is governed by the provincial *Environmental Management Act*. The Kelvin Grove WWTP operates under permit number 5188 (the "Permit") which regulates the quantity and quality of the plant's discharge. The parameters stipulated in the Permit are as follows:

Parameter	Permit Value
Volume (m^3/day)	340
BOD_5 (mg/L)	45
TSS (mg/L)	60

Water Quality

Reporting requirements consist of quarterly sampling of treated wastewater for five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) as well as the submission of an annual report to the Ministry of the Environment each January.

The following graph indicates daily wastewater discharge volumes for 2018 (black line) in comparison to the previous two years – at no time did the plant exceed the maximum discharge volume. Detailed daily flow tables for 2018 are contained in Appendix 2.



The following table indicates quarterly sampling results for five-day biological BOD_5 and TSS. Complete laboratory analysis records are contained in Appendix 3.

Date	BOD_5 (mg/L) Max 45	TSS (mg/L) Max 60
16-JAN-18	36.2	24.6
24-APR-18	26.6	33.1
25-JUL-18	8.9	12.6
18-OCT-18	3.8	10.6

As indicated by the table above, the sampling results were within permit compliance parameters for 2018. BOD_5 and TSS are governed by microbial activity and system efficiency. Temperature affects the operation of the treatment system and as indicated in the above table, colder temperatures in the late fall and early spring likely reduced biological activity thereby reducing their ability to reduce BOD_5 and TSS levels.

Maintenance

In accordance with the Permit, regular inspection and maintenance activities are conducted to keep the facility in good working order. Biweekly inspections are performed to check for vandalism, damage to the media disks, misalignment or excessive shaft deflection, motor torque loading (excessive heat), and for clogging of weirs or orifice areas. At the time of inspection, grease fittings and bearings are lubricated.

In December of 2018, routine inspections identified a defect in the mechanical components of the RBC. The main sprocket driving the shaft and media pack lost some teeth resulting in damage to the chain and gear reducer. While serious in nature, the defects have not impacted the rotation rate of the media packs and the overall functioning of the system. Replacement parts were ordered and are expected to arrive in early February 2019 after which staff will conduct the required repairs.

Annual Dewatering

Annual dewatering or removal of the sludge from the primary and secondary clarifiers is carried out in the fall of each year. This labour and resource intensive process involves the removal of the roof, pressure washing of clarifiers, and vacuuming out the sludge accumulations from the

bottom of the chambers. During this maintenance activity, a detailed inspection of the bearings, shaft, motor and media disc occurs with repairs or maintenance performed as needed.

Outfall Pipe Inspection

Quinquennial inspection of the WWTP wastewater outfall pipe is performed by certified divers or remotely operated vehicles. Video footage of the inspection is reviewed and analyzed with remedial measures budgeted and scheduled as required.

A video inspection was conducted early in the New Year with no significant deficiencies identified. The inspection report is attached as Appendix 4. Two minor issues were noted:

- The outfall pipe diffuser appeared to be covered in sediment, and
- The outfall signage is obscured by vegetation

Planned remediation:

- Staff will continue to monitor the metering chamber for backup thereby indicating obstruction of the outfall pipe, and
- a new outfall sign will be installed at a location more visible to boaters.

The next outfall dive is scheduled to take place during the 2023 calendar year.

Facility Classification and Operator Certification

The Kelvin Grove WWTP has been evaluated as a Small Wastewater System (Lagoon) by the Environmental Operators Certification Program Society (EOCP). One employee completed certification for the operation of the plant in 2018 and a second operator is expected to complete certification in 2019.

Appendix 1 – Sanitary Sewer System Diagram

Appendix 2 – Daily Flow Monitoring Logs

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
1-Jan-18	78019.38	1.73	13:56	0.34	5:34	7	17:48	6	5:08
2-Jan-18	68223.05	1.79	20:10	0.33	4:31	7	21:06	6	6:16
3-Jan-18	61013.85	1.5	16:36	0.31	3:41	8	19:16	7	5:44
4-Jan-18	61082.79	1.48	9:13	0.28	3:36	8	23:42	7	5:22
5-Jan-18	72483.37	1.53	17:17	0.33	4:20	9	22:22	8	0:47
6-Jan-18	75508.94	1.94	16:43	0.42	3:53	9	17:51	8	3:59
7-Jan-18	79283.39	1.71	9:49	0.42	3:02	9	0:17	8	23:22
8-Jan-18	79595.46	1.67	8:31	0.46	2:12	9	22:29	8	3:41
9-Jan-18	76149.83	1.54	16:44	0.46	5:01	9	11:28	8	4:26
10-Jan-18	61265.4	1.23	21:44	0.18	10:50	9	12:39	8	10:50
11-Jan-18	62979.03	1.49	19:31	0.29	4:33	9	0:06	8	17:42
12-Jan-18	70574.51	1.64	16:48	0.35	3:39	8	0:04	8	5:40
13-Jan-18	84067.85	1.82	10:52	0.54	5:11	9	21:11	8	3:06
14-Jan-18	73408.37	1.67	19:13	0.36	4:55	9	21:49	8	6:43
15-Jan-18	72228.62	1.62	23:03	0.3	3:24	9	21:37	8	6:13
16-Jan-18	71066.6	1.67	20:43	0.4	5:00	9	20:00	9	3:12
17-Jan-18	90987.41	1.79	19:00	0.45	4:45	9	0:05	9	8:47
18-Jan-18	83646.07	1.63	19:09	0.57	3:47	9	0:04	9	10:28
19-Jan-18	72982.17	1.68	22:23	0.39	3:20	9	0:12	8	23:59
20-Jan-18	73995.98	1.51	10:54	0.39	4:16	9	0:51	8	23:51
21-Jan-18	199790.2	6.33	9:13	0.82	23:59	8	4:56	8	23:39
22-Jan-18	68058.76	1.39	8:17	0.46	3:48	8	11:54	8	5:14
23-Jan-18	64057.27	1.42	9:03	0.24	4:47	8	1:46	8	11:15
24-Jan-18	75064.27	1.88	21:51	0.4	3:21	8	19:17	8	1:45
25-Jan-18	64833.5	1.4	20:14	0.43	5:25	8	0:00	8	23:51
26-Jan-18	55721.61	1.45	9:30	0.32	3:34	8	18:36	7	8:21
27-Jan-18	74485.39	1.78	9:31	0.27	3:07	8	22:35	7	6:38
28-Jan-18	87051.96	1.98	19:56	0.32	5:24	8	23:32	7	6:16
29-Jan-18	106119.8	2.12	7:31	0.69	0:48	9	15:06	8	1:41
30-Jan-18	65566.36	2.15	21:43	0.31	13:19	8	0:00	8	23:59
1-Feb-18	53476.12	1.83	7:29	0.23	3:32	8	23:33	7	5:39
2-Feb-18	55762.44	1.42	8:12	0.2	3:24	8	21:56	7	3:20
3-Feb-18	64328.76	1.39	16:53	0.3	3:51	9	23:12	8	0:09
4-Feb-18	71671.37	1.5	8:38	0.36	5:16	9	22:56	9	7:35
5-Feb-18	61689.17	1.74	21:31	0.33	4:43	9	0:10	9	23:47
6-Feb-18	58197.9	1.24	9:22	0.26	3:51	9	20:30	9	5:56
7-Feb-18	62939.94	2.63	18:49	0.26	5:37	9	23:36	9	5:42

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
8-Feb-18	58042.86	1.55	21:28	0.27	4:58	10	14:28	9	23:54
9-Feb-18	55087.26	1.4	7:13	0.24	4:55	9	0:03	8	23:53
10-Feb-18	55541.16	1.4	9:44	0.27	1:51	9	0:06	8	23:15
11-Feb-18	61175.86	1.54	9:45	0.25	4:00	8	16:27	7	8:06
12-Feb-18	64726.66	1.93	20:01	0.23	3:35	8	0:41	7	7:27
13-Feb-18	61537.7	1.58	20:12	0.33	4:18	7	16:34	7	5:50
14-Feb-18	64472.55	1.77	21:46	0.32	2:46	7	16:35	6	6:28
15-Feb-18	55665.48	1.28	21:42	0.25	3:37	7	21:47	7	5:57
16-Feb-18	51621.02	1.19	8:26	0.21	4:57	8	21:43	7	5:23
17-Feb-18	59378.4	1.78	18:06	0.23	3:05	8	18:56	7	22:46
18-Feb-18	66266.9	1.56	9:39	0.26	5:55	8	0:01	6	23:53
19-Feb-18	64968.76	1.62	21:05	0.22	3:23	6	0:00	5	5:29
20-Feb-18	60016.11	1.86	21:46	0.25	2:38	6	22:14	5	5:45
21-Feb-18	59645.22	1.59	19:33	0.23	2:46	6	0:11	5	4:04
22-Feb-18	59108.95	1.42	7:37	0.23	5:17	6	12:31	5	5:21
23-Feb-18	65190.66	1.37	21:37	0.2	5:43	6	0:18	5	5:28
24-Feb-18	61222.36	1.51	12:28	0.26	4:10	6	13:06	5	5:53
25-Feb-18	70794.85	2.09	10:19	0.21	2:18	7	15:43	6	0:27
26-Feb-18	62387.69	1.67	7:50	0.22	2:04	7	22:02	6	3:33
27-Feb-18	57219.42	1.63	19:17	0.2	2:18	7	19:32	6	5:02
28-Feb-18	67311.51	1.87	23:07	0.24	5:10	7	23:41	7	5:23
1-Mar-18	85862.54	1.84	2:00	0.48	23:51	8	15:57	7	6:26
2-Mar-18	58101.87	1.72	7:12	0.29	4:50	7	16:54	7	5:46
3-Mar-18	61138.85	1.89	10:05	0.27	2:36	8	15:30	7	5:03
4-Mar-18	64346.94	1.99	21:50	0.22	5:36	8	16:14	7	6:54
5-Mar-18	56259.81	1.42	7:14	0.21	2:31	8	19:50	7	6:02
6-Mar-18	53958.91	1.58	8:05	0.21	1:55	9	15:34	7	4:34
7-Mar-18	62453.48	1.74	7:34	0.24	5:16	8	23:15	7	6:40
8-Mar-18	75229.24	1.68	19:49	0.32	3:51	8	21:23	8	5:31
9-Mar-18	89550.27	1.7	18:56	0.66	12:33	9	16:14	8	9:41
10-Mar-18	75452.08	1.7	7:47	0.43	3:21	9	16:16	7	6:58
11-Mar-18	72932.42	1.86	19:21	0.35	3:46	9	17:39	8	4:09
12-Mar-18	73563.59	1.62	20:10	0.41	4:30	10	19:55	9	4:36
13-Mar-18	72946.11	1.72	21:51	0.43	23:59	10	15:13	10	23:50
14-Mar-18	67577.3	1.5	20:18	0.37	2:05	10	15:43	9	22:48
15-Mar-18	68987.2	1.82	6:49	0.32	1:42	10	17:52	9	9:04
16-Mar-18	72409.02	1.54	19:55	0.35	2:16	10	16:26	9	9:15
17-Mar-18	98636.14	2.08	7:07	0.46	2:02	10	16:35	9	9:03
18-Mar-18	81119.57	1.64	20:07	0.32	4:16	10	16:22	9	2:25

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
19-Mar-18	80906.08	1.68	21:38	0.4	23:59	10	15:30	9	5:13
20-Mar-18	72337.11	1.5	6:39	0.34	3:07	10	16:19	10	21:43
21-Mar-18	66287.75	1.35	21:00	0.34	1:58	10	19:48	9	5:37
22-Mar-18	116781.8	2.07	10:16	0.51	0:22	10	0:22	9	23:50
23-Mar-18	89829.92	1.55	18:18	0.58	1:51	9	0:02	8	7:13
24-Mar-18	78836.79	1.66	8:48	0.56	23:47	9	15:01	8	5:43
25-Mar-18	83680.17	1.9	8:04	0.38	4:39	9	17:11	8	4:00
26-Mar-18	75622.35	1.43	22:31	0.38	1:15	9	19:34	9	4:46
27-Mar-18	94887.49	1.83	7:02	0.56	0:53	10	18:13	9	1:49
28-Mar-18	82713.35	2.17	21:25	0.55	3:22	10	15:13	9	9:52
29-Mar-18	76633	1.6	7:46	0.58	22:56	10	15:45	9	2:15
30-Mar-18	75753.54	1.93	8:22	0.39	1:31	10	17:49	9	3:56
31-Mar-18	70206.91	1.52	8:42	0.35	1:44	10	18:04	9	3:10
1-Apr-18	79317.79	1.45	10:32	0.35	3:07	10	14:03	9	17:42
2-Apr-18	78986.66	1.85	9:43	0.48	2:53	10	18:42	9	10:43
3-Apr-18	73315.89	1.58	18:43	0.36	1:47	10	22:12	9	0:03
4-Apr-18	69528.3	1.43	6:08	0.32	1:47	10	15:09	9	5:00
5-Apr-18	82404.38	1.93	16:53	0.39	2:07	10	23:55	9	4:37
6-Apr-18	81661.51	1.86	8:21	0.49	4:23	11	22:51	10	3:16
7-Apr-18	131344.3	2.94	9:54	0.46	1:56	11	0:05	10	3:37
8-Apr-18	143709.4	2.63	8:54	0.9	23:59	11	18:11	10	8:26
9-Apr-18	95099.13	1.87	8:58	0.5	23:59	11	16:42	10	6:38
10-Apr-18	79520.9	2.09	8:15	0.37	3:22	11	18:07	10	7:52
11-Apr-18	96994.39	2.39	21:51	0.39	3:18	11	0:00	10	23:38
12-Apr-18	97568.52	2.14	21:40	0.64	23:59	11	15:00	10	9:00
13-Apr-18	78901.95	1.73	6:38	0.46	2:07	10	0:51	9	17:56
14-Apr-18	78640.87	1.63	17:12	0.41	3:07	10	14:53	9	5:30
15-Apr-18	96228.94	2.35	21:35	0.48	2:19	11	15:51	10	5:09
16-Apr-18	86150.26	1.74	6:34	0.62	23:30	10	0:10	10	23:53
17-Apr-18	76458.7	1.81	20:05	0.43	1:53	11	15:06	10	10:54
18-Apr-18	77642.8	1.93	18:31	0.4	3:06	11	16:57	10	4:39
19-Apr-18	73231.21	1.65	18:24	0.36	2:40	11	18:22	10	7:53
20-Apr-18	72289.36	1.57	6:33	0.38	2:33	11	14:08	11	6:26
21-Apr-18	76723.74	1.85	8:15	0.4	2:28	11	14:44	10	5:25
22-Apr-18	79555.05	1.8	8:09	0.35	1:49	12	18:16	10	5:51
23-Apr-18	74103.32	1.87	20:17	0.38	3:55	13	18:54	11	8:26
24-Apr-18	79167.97	1.89	6:49	0.36	0:21	14	18:05	12	8:57
25-Apr-18	78844.39	1.74	17:21	0.47	23:41	14	19:53	12	8:11
26-Apr-18	73969.02	2.6	16:52	0.3	1:07	15	17:19	13	8:01

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
27-Apr-18	69460.84	1.71	7:41	0.26	2:07	16	14:05	14	8:37
28-Apr-18	86575.3	1.82	17:56	0.35	4:27	15	0:10	13	23:58
29-Apr-18	89175.92	1.83	12:45	0.47	2:36	13	0:04	12	7:04
30-Apr-18	81905.1	2	20:14	0.39	1:18	13	17:17	12	5:27
1-May-18	80227.27	1.83	17:51	0.41	1:33	14	16:44	12	5:09
2-May-18	76837.21	1.77	20:45	0.37	3:15	15	19:15	13	7:50
3-May-18	66253.88	1.6	6:54	0.32	23:57	15	18:17	13	5:47
4-May-18	61059.23	1.44	7:21	0.18	1:59	15	0:45	14	23:57
5-May-18	69621.94	3.91	9:16	0.21	2:06	16	18:50	13	9:34
6-May-18	64595.47	2.15	9:28	0.2	3:59	17	20:29	15	8:24
7-May-18	59282.75	1.74	6:18	0.18	3:33	17	15:43	15	8:20
8-May-18	57279.51	1.54	6:24	0.2	2:58	17	19:05	15	8:17
9-May-18	62768.06	2.08	18:12	0.21	2:41	17	0:00	15	11:20
10-May-18	60680.27	1.64	6:14	0.22	4:24	16	15:44	15	6:57
11-May-18	58476	1.7	5:57	0.21	2:31	16	18:55	14	10:11
12-May-18	62006.5	1.65	9:33	0.21	1:15	17	18:25	15	8:28
13-May-18	70486.31	1.79	20:15	0.26	1:57	18	20:45	16	8:17
14-May-18	56571.76	1.49	6:29	0.19	4:00	19	21:25	17	10:37
15-May-18	59856.77	1.76	6:36	0.2	3:12	19	15:57	17	9:57
16-May-18	60432.31	1.46	18:47	0.27	1:40	18	0:05	17	23:53
17-May-18	57230.74	1.47	6:35	0.21	1:50	17	15:31	16	9:46
18-May-18	58020.58	1.6	21:23	0.21	2:04	16	17:07	16	6:41
19-May-18	55858.59	1.7	9:04	0.24	3:43	16	17:57	16	7:23
20-May-18	60802.11	1.54	12:01	0.22	2:42	17	18:25	16	5:29
21-May-18	69152.24	2.21	11:49	0.22	1:32	18	15:37	16	8:07
22-May-18	60617.53	1.71	6:29	0.3	1:34	18	20:19	16	10:09
23-May-18	58740.25	1.79	6:24	0.24	1:25	19	15:55	16	9:50
24-May-18	57593.33	1.51	21:45	0.22	1:26	19	15:42	17	9:10
25-May-18	59279.76	1.66	7:23	0.24	2:40	19	15:37	17	10:06
26-May-18	68378.65	1.68	9:17	0.32	1:17	18	17:44	16	8:53
27-May-18	71994.04	2.11	21:31	0.35	3:20	19	17:50	16	8:19
28-May-18	68166.4	1.53	21:39	0.3	3:19	19	15:21	17	7:37
29-May-18	70313.31	2.29	6:34	0.31	0:59	18	15:34	16	11:11
30-May-18	71669.24	1.79	6:37	0.29	2:02	18	15:40	16	10:14
31-May-18	68628.38	1.83	5:46	0.3	1:26	18	15:20	16	9:53
1-Jun-18	71259.97	1.62	20:45	0.3	3:42	17	0:01	16	23:55
2-Jun-18	72489.31	1.64	7:46	0.32	1:52	17	20:15	15	6:29
3-Jun-18	79951.42	1.98	18:30	0.34	4:49	17	0:01	16	23:51
4-Jun-18	103740.5	2.8	7:26	0.63	1:31	17	15:18	15	11:37

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
5-Jun-18	98134.7	2.19	6:35	0.52	22:59	16	0:02	15	23:52
6-Jun-18	69392.2	1.72	6:57	0.3	1:29	17	20:22	15	5:11
7-Jun-18	65930.78	1.69	6:42	0.32	2:32	17	0:00	16	23:53
8-Jun-18	75212.54	2.08	21:43	0.33	3:07	16	0:00	15	23:56
9-Jun-18	80605.71	1.8	7:38	0.44	4:29	16	15:22	15	9:40
10-Jun-18	80253.48	1.65	9:47	0.36	3:15	17	15:18	15	10:45
11-Jun-18	73123.73	2.18	21:30	0.3	1:25	17	15:24	15	10:25
12-Jun-18	73533.69	1.8	18:56	0.37	1:20	16	0:00	15	5:10
13-Jun-18	77753.68	1.93	6:30	0.35	1:50	16	15:37	15	10:30
14-Jun-18	74193.91	1.98	6:20	0.36	1:47	16	15:27	15	4:31
15-Jun-18	78652.31	1.81	8:30	0.36	2:14	17	21:55	15	4:22
16-Jun-18	78880.2	2.94	9:26	0.41	4:02	18	22:03	16	8:08
17-Jun-18	81138.94	2.14	21:43	0.39	2:00	19	21:33	17	8:45
18-Jun-18	77041.5	1.72	8:10	0.33	2:52	21	20:52	18	7:09
19-Jun-18	78417.31	1.95	6:26	0.4	23:43	21	18:42	19	10:09
20-Jun-18	77085.18	2	21:41	0.32	2:31	21	18:02	19	8:18
21-Jun-18	76335.9	1.75	20:26	0.37	3:24	21	16:26	19	10:03
22-Jun-18	89055.56	1.84	6:27	0.52	0:39	20	0:00	18	23:23
23-Jun-18	78973.84	1.72	21:48	0.37	2:21	19	15:33	18	10:20
24-Jun-18	81392.03	1.86	21:14	0.28	3:17	19	0:00	17	23:49
25-Jun-18	81633.17	1.63	8:03	0.43	3:08	18	17:01	17	11:00
26-Jun-18	73122.21	1.56	21:45	0.36	2:12	19	15:32	17	10:25
27-Jun-18	79774.32	1.81	20:25	0.4	1:53	19	17:26	17	10:32
28-Jun-18	79307.92	1.8	18:10	0.38	2:34	19	0:00	17	11:50
29-Jun-18	80495.65	1.75	21:49	0.4	0:17	17	0:04	17	15:16
30-Jun-18	83997.58	1.9	12:23	0.41	3:05	17	19:14	17	5:48
1-Jul-18	79266.59	1.76	8:37	0.42	1:48	18	15:16	17	5:23
2-Jul-18	84077.48	1.81	21:51	0.39	3:05	18	17:09	17	10:31
3-Jul-18	76646.62	1.69	20:05	0.32	2:52	19	18:59	17	9:49
4-Jul-18	76251.56	1.74	20:23	0.36	1:40	20	21:14	17	9:11
5-Jul-18	77212.94	1.83	21:46	0.33	1:36	21	20:24	19	8:06
6-Jul-18	85464.35	1.78	20:53	0.36	2:33	21	15:15	19	23:53
7-Jul-18	91090.06	2.1	8:38	0.41	2:00	20	15:37	18	9:38
8-Jul-18	95416.06	2.23	8:25	0.38	3:25	20	20:03	18	9:54
9-Jul-18	83345.84	1.69	21:44	0.36	2:01	20	0:00	19	23:43
10-Jul-18	80602.67	1.58	8:14	0.41	3:55	19	0:04	18	23:52
11-Jul-18	82048.45	2.18	21:37	0.32	2:31	20	19:21	18	5:20
12-Jul-18	72657.37	1.6	6:35	0.36	4:03	21	18:17	19	8:49
13-Jul-18	74411.18	1.44	6:38	0.35	2:45	21	19:16	19	10:13

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
14-Jul-18	80051.85	1.78	21:30	0.38	4:17	22	19:46	19	10:22
15-Jul-18	80321.82	1.72	11:35	0.38	3:42	22	18:20	20	9:56
16-Jul-18	80709.67	1.61	19:07	0.36	3:17	22	18:17	20	10:25
17-Jul-18	77869.15	2.04	21:33	0.35	3:20	22	18:55	20	9:48
18-Jul-18	72667.17	1.68	18:43	0.36	2:08	22	17:58	20	10:45
19-Jul-18	72989.94	1.76	21:02	0.34	3:12	21	0:03	20	23:58
20-Jul-18	80159.23	1.73	21:28	0.35	1:42	21	15:45	19	10:56
21-Jul-18	77693.63	2.15	9:05	0.39	4:23	20	18:46	19	10:35
22-Jul-18	73416.87	1.78	8:27	0.35	3:48	21	20:50	19	9:14
23-Jul-18	76078.04	1.79	18:53	0.34	3:56	22	18:58	20	8:53
24-Jul-18	71823.69	1.55	6:28	0.36	3:30	22	19:02	20	8:40
25-Jul-18	74834.25	1.7	21:31	0.34	1:15	23	17:48	21	10:02
26-Jul-18	78700.97	1.82	21:37	0.42	2:47	23	19:11	21	8:27
27-Jul-18	80305.21	1.84	8:31	0.39	1:00	23	15:51	21	9:25
28-Jul-18	79483.23	1.62	8:40	0.41	3:18	23	17:53	21	8:13
29-Jul-18	90546.55	1.87	21:23	0.5	3:12	23	19:13	21	8:19
30-Jul-18	80056.25	1.59	15:46	0.39	2:56	23	19:50	22	7:56
31-Jul-18	77427.26	1.75	19:23	0.41	2:30	23	15:38	22	8:38
1-Aug-18	84459.38	2.12	19:06	0.41	2:12	23	0:00	21	9:46
2-Aug-18	81000.86	1.58	8:43	0.41	3:24	21	0:02	20	9:29
3-Aug-18	76617.27	2.01	20:14	0.4	3:49	21	18:10	20	9:27
4-Aug-18	88646.52	1.97	21:29	0.39	2:04	21	19:23	19	10:18
5-Aug-18	84705.13	1.8	9:18	0.44	4:43	22	18:31	20	9:57
6-Aug-18	95614	3.49	9:27	0.45	0:54	22	16:42	21	9:58
7-Aug-18	93138.95	2.08	21:42	0.5	2:29	23	17:49	21	8:34
8-Aug-18	89515.67	1.87	17:45	0.49	3:08	23	18:12	21	9:23
9-Aug-18	89410.33	1.61	20:14	0.53	3:14	23	18:33	22	8:19
10-Aug-18	90783.28	1.89	7:22	0.54	3:12	23	19:26	22	8:13
11-Aug-18	89923.55	1.79	8:27	0.53	4:39	23	0:00	21	23:48
12-Aug-18	96915.96	2.33	9:11	0.56	4:39	21	0:00	20	23:58
13-Aug-18	89615.91	2.15	21:45	0.5	3:38	20	18:20	19	4:15
14-Aug-18	93486.62	1.88	21:22	0.55	0:55	21	19:32	20	9:04
15-Aug-18	92170.76	2.26	8:28	0.5	2:33	21	18:11	20	6:37
16-Aug-18	88424.7	1.8	21:26	0.5	3:51	21	15:58	20	10:26
17-Aug-18	90270.19	1.79	8:04	0.51	2:53	21	15:30	20	10:46
18-Aug-18	93907.76	1.75	9:00	0.59	3:51	20	19:09	19	7:31
19-Aug-18	93767.25	2.06	10:21	0.51	2:42	20	17:15	19	6:46
20-Aug-18	96242.4	1.78	20:19	0.51	2:47	21	21:04	19	9:53
21-Aug-18	95166.28	1.79	8:53	0.52	1:35	21	18:22	20	10:27

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
22-Aug-18	88498.73	1.81	21:43	0.5	1:30	21	0:00	20	9:49
23-Aug-18	89452.24	1.66	17:10	0.49	4:04	20	0:00	19	23:52
24-Aug-18	93933.33	1.89	19:50	0.49	2:39	19	15:09	19	10:49
25-Aug-18	91696.74	2.73	9:06	0.5	2:49	19	0:32	18	23:51
26-Aug-18	86410.98	2.29	18:01	0.47	4:24	19	19:18	18	5:21
27-Aug-18	88473.26	1.97	20:22	0.44	4:05	19	19:19	18	10:21
28-Aug-18	88922.1	1.88	6:37	0.46	1:04	19	17:25	18	10:42
29-Aug-18	89097.26	1.76	18:35	0.5	3:44	19	14:59	19	2:28
30-Aug-18	82547.36	1.88	7:57	0.51	1:22	19	16:33	18	10:37
31-Aug-18	89691.36	1.88	7:30	0.54	3:55	19	17:28	19	10:48
1-Sep-18	79983.6	1.83	9:20	0.51	2:50	19	14:00	18	10:40
2-Sep-18	75677.25	1.61	9:17	0.37	2:14	19	18:19	18	10:45
3-Sep-18	85498.59	1.85	18:45	0.35	1:38	19	14:06	18	10:35
4-Sep-18	78863.98	1.64	19:02	0.37	3:37	19	18:01	18	10:07
5-Sep-18	77968.48	1.77	19:35	0.4	1:15	19	17:05	18	10:36
6-Sep-18	84191.97	1.85	7:02	0.39	3:57	20	17:40	18	8:06
7-Sep-18	79810.37	1.63	6:20	0.46	2:26	19	0:04	19	23:47
8-Sep-18	80985.2	2	8:57	0.44	1:41	19	13:35	18	23:53
9-Sep-18	90495.76	2	15:40	0.39	2:35	18	0:02	18	23:59
10-Sep-18	81828.68	1.63	16:49	0.39	1:45	18	0:03	17	4:27
11-Sep-18	78329.11	1.82	6:17	0.41	1:52	18	18:40	17	4:49
12-Sep-18	79679.89	1.76	18:40	0.4	2:22	17	18:31	17	4:28
13-Sep-18	79332.33	1.73	12:13	0.36	2:34	17	15:17	17	5:08
14-Sep-18	78871.75	1.82	9:16	0.44	3:14	17	18:34	17	4:58
15-Sep-18	99824.53	2.31	16:58	0.49	5:20	17	0:05	16	23:58
16-Sep-18	134389.6	2.93	8:09	0.68	23:47	17	0:02	16	23:51
17-Sep-18	88393.61	1.95	6:28	0.52	3:54	16	19:03	16	5:06
18-Sep-18	83323.63	1.97	19:02	0.43	2:11	16	19:12	15	5:57
19-Sep-18	82893.72	2.02	19:08	0.46	2:21	16	17:24	15	4:53
20-Sep-18	85402.04	1.69	9:03	0.48	2:30	16	0:06	16	23:54
21-Sep-18	111115.4	2.34	8:34	0.87	23:30	16	0:04	15	23:52
22-Sep-18	120870.7	2.93	7:59	0.73	1:29	16	15:03	15	4:56
23-Sep-18	90232.39	1.94	20:00	0.55	5:26	16	0:00	15	23:53
24-Sep-18	89427.63	2.24	21:37	0.46	2:25	16	20:34	15	5:15
25-Sep-18	77840.31	1.53	7:00	0.42	2:01	16	17:29	15	9:42
26-Sep-18	83791.49	2.53	17:13	0.44	3:58	16	17:24	15	5:21
27-Sep-18	82655.15	1.76	6:02	0.42	1:18	16	16:13	16	4:56
28-Sep-18	74499.37	2.16	7:29	0.38	1:54	17	17:45	16	9:06
29-Sep-18	77685.29	2.15	8:28	0.37	4:41	17	0:28	16	23:57

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
30-Sep-18	99162.12	2.16	21:38	0.46	3:20	16	0:00	15	23:56
1-Oct-18	97008.38	2.38	6:14	0.59	23:59	15	0:01	15	5:46
2-Oct-18	80494.22	1.9	18:11	0.48	1:35	15	0:00	14	23:49
3-Oct-18	85659.27	1.88	21:50	0.42	2:18	14	0:00	13	23:56
4-Oct-18	89517.72	2.21	6:24	0.44	2:49	14	18:36	13	5:04
5-Oct-18	86902.76	1.62	7:34	0.5	3:43	14	18:44	13	5:06
6-Oct-18	88629.34	1.74	8:41	0.48	4:49	14	16:58	13	5:53
7-Oct-18	95498.8	3.81	11:35	0.39	3:29	14	14:35	14	6:43
8-Oct-18	90274.75	1.91	20:35	0.43	3:55	14	19:19	14	6:20
9-Oct-18	81202.78	1.92	21:45	0.4	0:31	15	22:14	14	4:49
10-Oct-18	71385.31	1.64	6:42	0.4	3:09	15	11:53	14	10:09
11-Oct-18	76713.48	2.06	6:45	0.39	3:43	15	0:11	14	9:19
12-Oct-18	79694.97	1.91	8:31	0.38	3:18	15	12:00	14	5:26
13-Oct-18	80249.75	2.17	20:24	0.38	3:04	15	15:03	14	10:32
14-Oct-18	93372.67	1.91	18:06	0.35	23:51	14	11:42	14	8:08
15-Oct-18	83679.6	1.7	6:09	0.37	1:14	14	21:50	14	9:03
16-Oct-18	78368.21	1.75	19:23	0.39	3:13	15	22:07	14	5:22
17-Oct-18	74718.69	1.82	6:42	0.37	3:54	15	16:46	14	2:13
18-Oct-18	76877.05	1.96	21:42	0.37	1:34	15	11:53	14	9:27
19-Oct-18	82083.52	1.83	20:52	0.44	3:53	15	12:01	14	9:50
20-Oct-18	80968.53	1.74	8:10	0.38	3:57	14	11:46	14	6:46
21-Oct-18	96386.86	2.15	10:20	0.53	3:16	14	11:51	14	5:26
22-Oct-18	94522.93	2.01	7:44	0.57	23:46	14	11:44	14	4:36
23-Oct-18	87727.37	1.67	20:18	0.37	1:12	14	19:01	13	11:20
24-Oct-18	25838.21	2.27	6:46	0.06	20:38	14	0:01	13	10:09
25-Oct-18	8055.21	0.12	12:16	0.07	1:57	13	0:19	13	23:52
26-Oct-18	67015.99	1.8	19:24	0.09	7:38	14	14:47	13	8:01
27-Oct-18	76344.99	1.88	8:33	0.41	4:19	13	17:24	13	6:54
28-Oct-18	82002.27	1.74	19:58	0.35	2:07	14	20:19	13	5:56
29-Oct-18	84386.86	1.7	7:20	0.45	23:59	13	0:06	13	23:52
30-Oct-18	69182.19	1.72	21:52	0.32	0:42	13	22:00	13	4:15
1-Nov-18	89422.83	1.81	21:26	0.35	0:40	14	23:43	13	1:57
2-Nov-18	93083.1	1.96	11:04	0.51	23:15	14	14:12	14	0:06
3-Nov-18	82945.63	1.91	15:41	0.29	2:14	14	0:34	13	22:53
4-Nov-18	98842.1	2.27	9:10	0.57	23:49	14	11:23	13	23:46
5-Nov-18	67644.9	1.66	21:49	0.29	4:26	13	11:16	13	23:48
6-Nov-18	65319.41	1.65	7:27	0.29	1:52	13	0:01	13	15:55
7-Nov-18	63078.76	1.44	8:48	0.32	4:38	13	0:02	12	23:58
8-Nov-18	60564.48	1.64	22:01	0.31	2:11	12	0:03	11	12:43

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
9-Nov-18	64185.82	1.61	9:32	0.32	4:11	12	0:04	11	4:54
10-Nov-18	72611.76	1.49	10:12	0.35	6:01	12	11:34	11	6:20
11-Nov-18	72885.01	1.86	22:04	0.31	4:23	11	22:22	11	6:08
12-Nov-18	71091.06	1.51	10:09	0.32	3:51	12	21:03	11	6:35
13-Nov-18	76132.01	1.64	7:40	0.31	2:50	12	22:50	11	6:12
14-Nov-18	101232.9	1.95	6:48	0.77	3:35	12	18:54	11	10:13
15-Nov-18	78533.01	3.3	18:51	0.42	3:25	12	19:36	11	5:01
16-Nov-18	74366.27	1.58	9:50	0.47	2:46	12	11:32	11	23:11
17-Nov-18	77572.38	1.64	20:48	0.43	2:57	12	0:46	11	20:13
18-Nov-18	77535.97	1.59	11:50	0.42	3:56	11	0:08	10	7:46
19-Nov-18	71393.97	1.48	10:37	0.39	3:47	11	22:57	10	4:49
20-Nov-18	75315.88	1.65	21:39	0.42	3:41	11	22:16	10	2:43
21-Nov-18	87234.75	1.67	21:25	0.41	2:57	11	22:37	11	0:26
22-Nov-18	101113.7	1.79	16:49	0.72	12:43	11	8:38	11	15:54
23-Nov-18	96891.92	1.7	21:59	0.77	4:00	11	0:12	11	20:50
24-Nov-18	78501.53	1.67	9:30	0.48	5:19	11	0:00	10	6:47
25-Nov-18	85522.86	2	18:07	0.46	5:13	11	19:31	10	2:48
26-Nov-18	27516.84	2.07	7:31	0.48	1:56	11	8:15	10	1:59
27-Nov-18	195298	3.85	7:17	1.13	23:59	11	20:27	10	7:36
28-Nov-18	88645.28	1.77	7:39	0.7	23:59	11	0:03	10	21:18
29-Nov-18	71752.7	1.51	7:23	0.41	4:31	10	0:03	10	5:36
30-Nov-18	68841.07	1.6	7:17	0.41	3:44	10	0:03	10	3:42
1-Dec-18	70068.94	1.74	10:14	0.38	4:45	10	0:00	9	23:54
2-Dec-18	76109.23	1.83	22:59	0.36	5:05	10	11:46	9	8:12
3-Dec-18	69620.84	1.4	8:44	0.35	5:15	9	0:00	8	5:59
4-Dec-18	74107.51	1.6	20:33	0.3	2:50	9	0:07	8	6:34
5-Dec-18	67394.96	1.8	23:05	0.32	4:25	9	23:20	7	3:05
6-Dec-18	67175.99	1.52	8:33	0.32	3:33	8	0:01	7	4:49
7-Dec-18	68615.99	1.49	7:01	0.32	3:34	8	18:47	7	5:27
8-Dec-18	75427.32	1.65	10:11	0.33	3:55	9	23:38	8	1:45
9-Dec-18	99943.26	2.26	10:18	0.4	4:31	9	22:52	9	7:13
10-Dec-18	84336.99	1.95	23:21	0.59	3:28	10	23:25	9	1:27
11-Dec-18	123828.3	2.09	17:26	0.85	5:18	10	0:05	9	15:26
12-Dec-18	82024.61	1.82	7:53	0.54	4:50	9	0:03	9	20:21
13-Dec-18	129835.8	2.49	21:31	0.56	1:18	9	20:11	9	6:10
14-Dec-18	132774.1	2.58	3:30	0.99	23:59	9	17:39	9	22:27
15-Dec-18	77574.21	1.43	9:01	0.48	4:30	9	1:54	8	10:50
16-Dec-18	123916.6	2.5	17:53	0.45	2:42	10	23:52	9	0:33
17-Dec-18	110264.1	3.92	19:19	0.92	15:00	10	9:45	9	15:50

Date	Day Total (L)	Max. DF (L/sec.)	Max. DF Time (24 Hr.)	Min. DF (L/sec.)	Min. DF Time (24 Hr.)	Max. DF Temp. (°C)	Max. DFT Time (24 Hr.)	Min. DF Temp. (°C)	Min. DFT Time (24 Hr.)
18-Dec-18	161291.2	2.91	19:02	1.41	15:37	10	0:04	8	0:00
19-Dec-18	106712.5	1.99	0:01	0.83	23:10	9	0:23	9	6:34
20-Dec-18	145627.9	3.31	7:11	0.58	1:48	10	11:45	8	17:01
21-Dec-18	103643.2	1.88	8:01	0.73	23:46	9	0:01	8	22:39
22-Dec-18	120571.7	2.99	20:32	0.4	4:21	8	19:03	8	5:55
23-Dec-18	153202.6	2.86	10:19	1.23	2:05	9	23:07	8	10:28
24-Dec-18	126442.1	2.63	11:58	0.94	5:19	9	16:50	8	5:54
25-Dec-18	116256.5	2.39	10:22	0.75	4:53	8	0:24	8	6:35
26-Dec-18	111664.8	2.52	11:52	0.73	3:47	8	0:08	8	4:32
27-Dec-18	119493	2.58	12:18	0.8	5:10	8	0:25	7	12:52
28-Dec-18	122034.7	2.22	22:25	0.71	3:56	8	9:43	7	13:56
29-Dec-18	137278	2.72	11:30	0.93	4:37	9	20:04	7	2:26
30-Dec-18	112608.4	1.92	20:12	0.87	4:38	8	1:43	8	23:57
31-Dec-18	83148.27	1.8	11:00	0.66	23:04	8	0:01	7	18:39

Appendix 3 – Laboratory Analysis Records

Results Summary L2045427

Job Reference

Report To Naizam Jaffer, VILLAGE OF LIONS BAY

Date Received 16-Jan-2018 12:42

Report Date 25-Jan-2018 12:40

Report Version 1

Client Sample ID			SEWER TREATMENT PLANT
Date Sampled			16-Jan-2018
Time Sampled			12:10
ALS Sample ID			L2045427-1
Parameter	Lowest Detection Limit	Units	Water
Physical Tests (Water)			
Total Suspended Solids	3.0	mg/L	24.6
Aggregate Organics (Water)			
BOD	6.0	mg/L	36.2

Results Summary L2084148

Job Reference

Report To Naizam Jaffer, VILLAGE OF LIONS BAY

Date Received 24-Apr-2018 12:55

Report Date 4-May-2018 15:10

Report Version 1

Client Sample ID			SEWER TREATMENT PLANT
Date Sampled			24-Apr-2018
Time Sampled			12:00
ALS Sample ID			L2084148-1
Parameter	Lowest Detection Limit	Units	Water
Physical Tests (Water)			
Total Suspended Solids	3.0	mg/L	33.1
Aggregate Organics (Water)			
BOD	6.0	mg/L	26.6

Results Summary L2135676

Job Reference	
Report To	Naizam Jaffer, VILLAGE OF LIONS BAY
Date Received	25-Jul-2018 12:50
Report Date	7-Aug-2018 16:55
Report Version	1

Client Sample ID			SEWER TREATMENT PLANT
Date Sampled			25-Jul-2018
Time Sampled			12:00
ALS Sample ID			L2135676-1
Parameter	Lowest Detection Limit	Units	Water
Physical Tests (Water)			
Total Suspended Solids	3.0	mg/L	12.6
Aggregate Organics (Water)			
BOD	2.0	mg/L	8.9

Results Summary L2183334

Job Reference	
Report To	Naizam Jaffer, VILLAGE OF LIONS BAY
Date Received	18-Oct-2018 11:26
Report Date	23-Oct-2018 16:54
Report Version	1

Client Sample ID			SEWER TREATMENT PLANT
Date Sampled			18-Oct-2018
Time Sampled			10:30
ALS Sample ID			L2183334-1
Parameter	Lowest Detection Limit	Units	Water
Physical Tests (Water)			
Total Suspended Solids	3.0	mg/L	10.6
Aggregate Organics (Water)			
BOD	2.0	mg/L	3.8

Appendix 4 – Dive Inspection Report

CAN-DIVE CONSTRUCTION LTD.
Underwater Innovators Since 1966

CAN-DIVE CONSTRUCTION LTD.

LIONS BAY STP OUTFALL INSPECTION

JANUARY 15, 2019

TABLE OF CONTENTS

CAN-DIVE CONSTRUCTION LTD.
Underwater Innovators Since 1966

1 INTRODUCTION

Can-Dive Construction Ltd. has prepared the following report detailing the inspection of the Lions Bay STP Marine Outfall that was carried out on January 15, 2019.

2 SCOPE OF WORK

- Ensure the outfall is in good working condition.
- Examine the entire length of the pipes and diffusers for breaks, leaks or blockages
- Inspect and assess the condition of the outfall pipe anchoring
- List and provide a detailed description of deficiencies and provide recommendation

3 PERSONNEL

The following CAN-DIVE personnel were involved in the inspection of the outfalls:

- **Aron Kerwer**, *Diver/Diving Supervisor/ROV Operator*
- **Mark Kunyckyj**, *Diver/ROV Tender*
- **Kayle Houlihan**, *Diver*

4 RESULTS

LIONS BAY STP MARINE OUTFALL MP4 Video File: *Lions Bay STP Outfall Insp.mp4*

Figure 1 Foreshore and partially obstructed outfall signage

The Lions Bay STP Outfall point of daylight was easily found in approximately 33 fsw at high tide. The pipe is well protected by sand and rock looking inshore. An outfall sign was visible but partially obstructed by vegetation. Moving offshore, the pipe rests on the seabed with little to no cover. Pipe ballast is of the C-type, non-reinforced concrete strap-on weights. All weights were found in good condition with the metal banding only showing light surface corrosion. At a depth of approximately 200 fsw the outfall transitions from steep rock to level mud/silt bottom. At this point debris buildup was increasing on one side of the pipe - indication of strong bottom currents. Moving along towards the diffuser, the pipe becomes increasingly buried and difficult to follow. We believe the diffuser was found in approximately 277 fsw. However, the diffuser ports were not observed due to the amount of sediment cover on the pipe. Additionally, the outfall pipe was found to be much longer and deeper than specified.

Summary Deficiencies:

- Sedimentation of terminus
- Vegetation obstructing outfall signage

Recommendation:

- Monitor backflow of outfall discharge for potential obstruction
- Maintain a frequent inspection and monitoring program for outfall
- Clear vegetation obstruction outfall signage

5 LIONS BAY OUTFALL REFERENCE PHOTOS

Figure 2 Point of daylight approximately 33 fsw at high tide

Figure 3 Typical C-type strap-on weight

Figure 4 Sedimentation on north side of pipe, indicating strong bottom currents

7 CONCLUSION

I trust this information will meet with your approval. Thank you for allowing Can-Dive the opportunity to assist you with this project. Should you have any questions, or require further information, please do not hesitate to contact myself.

Best Regards,

Aron Kerwer
CAN-DIVE CONSTRUCTION LTD.
778-837-7800

THE MUNICIPALITY OF THE VILLAGE OF LIONS BAY

INFRASTRUCTURE COMMITTEE

TERMS OF REFERENCE

Purpose

To advise Council on the establishment of policies, bylaws and matters related to infrastructure planning, development and maintenance in the Village.

Establishment and Authority

Section 141 of the Community Charter provides the Mayor with the authority to establish Standing Committees. The Infrastructure Committee (the "Committee") was amended from a Select Committee to a Standing Committee by a resolution of Council on January 6, 2015.

The Committee's role is advisory; it has no authority to approve or implement decisions. The Committee shall report directly to Council through its Chair.

Composition

The Committee shall be comprised of equal numbers of members of Council, and members of the public as appointed by the Mayor.

Committee Role and Responsibility

The Committee's role is to provide guidance and recommendations to Council with respect to Infrastructure as follows:

1. Suggest for Council's consideration revisions and/or updates to Village policies and bylaws with respect to infrastructure planning, development and maintenance.
2. Prepare and prioritize, for Council's consideration, a list of items to be included in the Village's budget for infrastructure planning, development and maintenance and recommend funding sources wherever possible.
3. Other items as may be assigned, by Council, to the Committee related to infrastructure planning, development, maintenance and funding.
4. Defer to Village staff for the day-to-day operations of the Village; Committee input will be at a strategic level.

Staff Role and Responsibility

1. Assists the Committee with information related to Village infrastructure planning, development and maintenance activities.
2. Bring forward Committee recommendations to Regular Council Meetings for consideration.
3. Manage the operation and contracts of activities related to infrastructure planning, development and maintenance for the Village.

Policies and Procedures

Committee procedures are in accordance with Part 4, Division 3 and Part 5, Divisions 2 and 4 of the BC Community Charter as well as the current version of the Village's Council Procedures Bylaw to the extent applicable.

The Committee is established as a non-voting structure, and its recommendations shall be formulated by consensus of those present at its meetings. In the event of procedural conflict, Roberts Rules of Order shall apply.

The Committee will appoint its own Chair and take descriptive minutes. Committee meetings shall not be recorded.

The Committee will meet on the 4th Monday of each month, subject to the Chair's ability to move meeting dates as necessary, in consultation with Committee members.

Adopted by Council:	February 17, 2015
Amended:	October 18, 2016
Amended:	November 20, 2018

ON-TABLE ITEMS

On Table

Attention:

Lions Bay Infrastructure Committee
Village of Lions Bay

February 27, 2019.

Dear Sirs:

It has been brought to my attention that the subject of redirecting the drainage runoff from the natural springs on upper Oceanview Road back to Rundle Creek is up for re-examination.

This is something I wish the Village to correct since the Village chose a course of action back in July 2005.

Within a very short period of time the adverse effects of re-directing the runoff from the springs from the properties situated above properties 260 and 270 Oceanview Road were seen; here the original culvert pipe channelled the run-off correctly to Rundle Creek, the closest creek to which Dawson Development correctly installed. Instead of replacing the culvert pipe on the Village's Right of Way to Rundle Creek, at the time it was lobbied to the Village to redirect the waterway to drain into a poorly designed in-efficient ditch. The ditches were originally meant only for the rain or snowmelt run-off from adjacent properties on the upper slope side of the road to drain into Harvey Creek. The engineer in 2005, who was contracted to redirect the spring runoff, was against redirecting the waterway into Harvey Creek, half way across the Village, but he was just following Village's orders. As a result, considerable damage to the Village ensued. A very dangerous situation unfolded. At the time sinkholes and extreme excessive water seepage was now undermining the roadway upper Oceanview Road above the T-intersection by Highview Place. After the black culvert was installed the water was able to flow better along a compromised stretch of Oceanview Road in the ditch until it reached the T-intersection. Now the water could flow further downhill beyond the T-intersection in the ditch where it also started eroding and damaging those areas too. I had warned the Village Council this would happen. It happened.

At that time, my father and I addressed the then council members, office administrators, the Mayor and Public Works to stop proceeding with altering the course of the flow of water to go along a temporary seasonal ditch that was made into a full time year round creek because of the natural spring being their water source. This new creek that was now to flow in a temporary ditch that was porous due to the nature of the soil structure. This new little creek was not just creating damaging results to the roadway but possibly at the time a deadly situation for some

residents in our community. I was documenting and monitoring the situation. For many years, I pursued subsequent councils that this dangerous problem must be remediated immediately. They brought in a Geotechnical engineer due to my continuous efforts to protect residents and our community from potential problems and I tried to address and advert future problems where the roadbed could be undermined especially where the water would flow in curves or against its natural tendency to flow downhill. Eventually, through my continues efforts, the black pipe was laid to alleviate a very dangerous situation – a sinkhole that lay alongside the slope, just to the right of the Oceanview / Highview intersection.

I was told the 2nd culvert pipe that was installed had collapsed. (The 2nd pipe had been installed when the Village sold 260 Oceanview Road land parcel to purchase what is today the emergency building's land). For a few years just prior to the collapse of the culvert, there was always very a large metal object stored on the Right of Way in proximity to the culvert pipe. (I assumed it was an aluminum mining sluice). Did its collapse have something to do with the weight compromising the drainage culvert integrity??? I do not know.

Whatever opposition there is - the safety, the resulting damage to the Village, the present expense to remediate such a fiasco from 2005 is not acceptable and must be corrected. It cannot be allowed to continue and it is best to repair and redirect the water flow back to its original outflow. Even Dawson Development understood it was the shortest, safest and most logical route for the runoff water.

Unfortunately, but understandably there are 2 residents that are unhappy with having the culvert re-established alongside Kelvin Groves water-line pipe on the Village of Lions Bay's Right of Way. They have spent many years landscaping and cultivation their gardens on the Village's Right of Way, but in the end it is the Village's Right of Way. Any maintenance or repairs needed to be done to anything on the Village's Right of Way must take priority, now and in the future. The Village is liable for their actions or inactions.

Attached I have provided a sample copy of a Delegation presentation I gave the Council and Mayor in 2008.

I have kept ALL correspondence with the Village for future reference. If you require more background knowledge, I'm happy to assist.
Thank you.

Regards,
Tina Schneider
[redacted] Oceanview Road (Original and 1st family who built in this area)
[redacted]

February 18, 2008 Council Meeting

Speakers for the Delegation:
Tina Schneider & Former Mayor Brenda Broughton

Subject of Delegation:

THE PROBLEM OF SINKHOLES AND WATER SEEPAGE ON OCEANVIEW ROAD AND THE HISTORY OF LIONS BAY'S CONCERNS REGARDING SINKHOLES IN THIS AREA.

My family and I have lived here for 37 ½ years. We were the first to build in this area and we remember how and where the natural water drainage in the whole area was before it was built upon.

I herewith wish to address our Mayor Mr. Wyman and our Councilors, about how imperative it is, that this matter requires more attention.

The formation of sinkholes and continuous water seepage is a direct result of the Village's decision in 2005. The Village redirected the flow of water from a collapsed culvert on their Right of Way to Rundle Creek. The water was re-routed from Rundle Creek to flow down Oceanview Road along a low grade porous gravel ditch.
At a casual observation, one might think that there is not much of a problem.
The lush vegetation covers up any problems and gives a false impression.

Background to the Area.
Originally, a portion of Oceanview Road was used as a gravel pit to ascertain gravel for building Highway 99.
Our road is made up of a combination of large boulders and gravel.
It was not built like our modern highway – compacted layered crushed rock.
There is no granite bedrock to channel and contain the water.
- Near the curve at 245 Oceanview Road, the soil is mostly comprised of a mixture of clay and gravel. Further down by the driveways of 265/275 Oceanview Road, the composite of soil becomes course gravel.

Where does the water come from?
Water seeps through the ground from Rundle Creek's springs and enters the ditch between 280 and 290 Oceanview Road.

Why does the stream fluctuate in water volume?
I've noticed, that the volume of water flowing in the ditch along Oceanview Road, has a direct correlation with how much water from the springs higher up gets absorbed into the ground. Heavy rains, snowmelt contribute to more water seeping and flowing out of the underground springs on 280 & 290 Oceanview Road, than in drier periods, when the pressure is less.
The springs never run dry like Harvey or Alberta Creeks in the summer. It flows year round like Rundle Creek. (Hence, the source of water supplying Harvey and Alberta Creeks are somewhat different).

How was the water dealt with in the past.
Dawson Development had made a culvert over what was formally Village property (now 260 Oceanview Road). The constant flow of water was diverted back to the nearest creek – Rundle Creek – approx. 25 m away.
I believe the metal culvert has been only replaced once – with the construction of Kelvin Grove's water pipe in mid 1980's.

What had changed?
A portion of the culvert pipe collapsed on the Village's Right of Way on 260 Oceanview Road. Instead of replacing the collapsed culvert pipe, the Village opted to direct the water flow away from Rundle Creek into the Village over a low gradient porous gravel bed that runs parallel to the contour of the slope.

Thus, by changing the course of the flow of water, the water was now in theory to flow approx. 900m into Harvey Creek. A creek ½ ways across the Village.

Result:
The water never manages to flow more that 200m from the new culvert before finding its way underground.

Where the water continues underground is unsure, but allowing constant erosion can jeopardize the road bed, and possibly the bank, which could give way.

The water doesn't always flow into the terminal sinkhole (the last hole the water vanishes into during heavy rains). Going down along the ditch one can noticeable see and hear where the water vanishes. During our heavy rains, the increased water coming from the springs is equivalent to a broken water-main. The extreme heavy volume of water disappears underground opposite a steep bank with houses below.
The land beside the road on the opposite side of the terminal sink hole has dropped 17" from the side of the road bed in the past 2 1/2years.
When there is less water flowing in the ditch, seepage, "pooling" (possible pre-cursers to sink holes), and smaller sinkholes absorb all the water.

Worse Case:
Depending upon the extent of the subterranean erosion, the boulders under the roadway may move, as sand pockets have been washed out. A little or a larger cavern could form. If the area receives external movement e.g. a tremor, or the ground becomes too saturated with water, it could also give way, where the above slope or the lower slope could slide down the bank onto the properties below. Another example of erosion is that the water could under-mine the road surface and the road could cave in.

Looking for Answers:
My father and I first started addressing the Village in the reasoning behind the redirection of the water flow, when they were installing the new culvert system in July 2005.
We knew at the time, that the Village's decision to alter the course of water was a dangerous one, and it would have repercussions in the future in safety and finances.

In questioning the foreman and crew in 2005, they indicated, that they were not happy with the Village's decision to direct this steady flow of water into the Village. They even were prepared to cease work, in a given time frame, depending on the stage of their work progress.

While expressing our safety concerns to 2 Councillors in 2005, we were told, "it was good what they did…leave the matter alone" and it was done for "purely financial reasons." None of their reasoning behind the decision addressed any of our safety concerns, which we knew would appear given time.

The ditches throughout the Village, I believe, were not designed to divert creeks and channel a continuous flow of water, but to catch excess water run-off (e.g. rainwater) from adjacent individual properties. At the time of the original development, some parts of Lions Bay were bare – treeless land – as it was on upper Oceanview Road, formerly a gravel pit.

Solutions.

Solution:
The best way to resolve this problem is to direct the run-off back to its original route via a culvert pipe on the Village's Right of Way and empties into Rundle Creek. This is the shortest and safest route and was proven for 35 years to be successful. It did not compromise the rest of Oceanview Roads safety.

I also ask the Village, to get a geohydrological engineer, to survey the area and see, if the sinkholes and the prolonged flow of water draining into the sinkholes have already compromised the subterranean area and the safety.

No Solution:
Leave the problem alone; fill the holes with sand again. This only addresses a small portion of the surface of the ditch, but it's not a preventive or a corrective action. Any heavy flow of water would soon wash the sand away and continue to erode the sub-terrain. This would be only a very temporary superficial act and not a solution.

Conclusion:
Because the water flows continuously year round and the sinkholes and seepage are a direct result of the 2005 decision, further erosion can only have a negative outcome to the Village. I urge the Village, to correct this potential dangerous problem by directing the water back into the Rundle Creek. This is shortest, safest and cheapest way.

We do not want to experience the problems of North Vancouver. Lions Bay continues to suffer from the stigma of our own tragic past. It's better to correct something still manageable than let erosion have a chance to create a more dangerous situation.

Thank you.

Tina Schneider
[redacted] Oceanview Road
[redacted]