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February 6, 2015

Engineering Department
Town of Gibsons
474 South Fletcher Road
Gibsons, BC V0N 1V0

Dear Sirs:

RE: WASTEWATER TREATMENT PLANT GRANT APPLICATION
TECHNICAL EXECUTIVE SUMMARY
Our File 2132.017-300

1. Introduction

Kerr Wood Leidal Associated Ltd. (KWL) was commissioned by the Town of Gibsons (Town) to perform an operational assessment of its existing Wastewater Treatment Plant (WWTP). The scope of work for the project had been divided into two separate groups of tasks. Two technical memoranda were prepared summarizing findings. In addition, a proposal for continued work in 2015 had also been prepared.

The purpose of the executive summary is to summarize the results of the audit, proposed work plan and estimated costs included in the three documents, which are appended to this letter:

1. Technical Memorandum No. 1 – Wastewater Treatment Plant Audit and Alkalinity Review (KWL, 2014);
2. Technical Memorandum No. 2 – Wastewater Treatment Plant Audit - Solids Dewatering (KWL, 2014); and
3. Proposal for 2015 WWTP Optimization and Upgrades (KWL, 2014).

2. Background

The Gibsons WWTP is located at 389 Stewart Road, west of the Town's commercial centre. Refer to Figure 1 for a location map.

The Town has identified two primary areas of concerns associated with the operation of the WWTP.

- **Alkalinity Control:** The WWTP was designed based on influent alkalinity levels of approximately 257 mg/L, but the actual alkalinity levels in the influent are approximately 140 mg/L (54% of design levels).
- **Dewatering System:** The design runtime for the WWTP centrifuge is approximately 30 hours per week and it is currently operating for approximately 63 hours per week.

Although the Town considered the two issues separate, the results of the audit indicate that not only are the two issues linked but there were other issues identified during the course of the audit related to the operation problems at the plant currently being encountered. In particular, issues meeting permit levels for effluent TSS, ammonia-nitrogen and fecal coliform were noted.

The key issues identified at the plant are as follows:

Influent Screens By-Passing and Lack of Flow Attenuation: The existing influent screens are regularly overwhelmed when the Prowse pumps are turned on. This results in regular by-passing of the screens and carry-over of rags and grit into the downstream treatment processes. The by-passing and excess solids make it more difficult to achieve consistent treatment in the secondary treatment train, which as noted below, has limited control option.

In addition to optimizing the operation of the influent screens, it is recommended that an equalization tank be installed upstream of the headworks screens to attenuate the peak system flows from the Prowse Pump Station The Prowse Pumping Station Review, completed by others at KWL, recommended optimizing the pump operation to reduce operating costs and diverting two gravity lines directly to the plant: these changes also require flow attenuation at the WWTP, upstream of the headworks.

Sequencing Batch Reactor Control Issues: Five high-priority operational concerns with the SBR were identified:

1. Uneven influent flow splitting resulting in different water levels in the SBR tanks;
2. Inadequate influent alkalinity for ammonia-nitrogen removal resulting in occasional permit infractions;
3. Limited control of SBR cycle programming resulting in sub-optimal operation;
4. Limited control and monitoring of WAS wasting resulting in poor control of reactor solids concentration and polymer injection; and
5. Lack of activated sludge return resulting in low biomass concentrations in the pre-react basin.

The proposed modification and upgrades to address items 1, 3, 4 and 5 are outlined in Section 3 – Workplan.

To address the alkalinity issues, item 2, chemical trials will be undertaken to optimize chemical selection and chemical addition. Once the preferred chemical has been identified, after trials and discussions with the Operators, a permanent chemical addition system will be sized. The final chemical selection will dictate the required storage facility size; consequently, funding related to chemical optimization and storage does not form part of this funding request.

Ammonia-Nitrogen Limit Exceedances: The plant periodically exceeds its ammonia-nitrogen discharge limit. Nitrifying bacteria are sensitive to pH fluctuations; at low pH, their growth rates are limited which results in decreased nitrification efficiency in the bioreactor. The optimal pH for nitrification is 8.0 and nitrification is limited below a pH of 6. Historical pH data (2006 to 2014) shows the pH levels are lower than the target pH of 6.8; the average pH over nine years was 6.6 and the minimum pH was 5.3.

Alkalinity addition, in the form of chemical, is required to achieve optimal pH in the reactor and improve ammonia-nitrogen removal.

Effluent Fecal Coliform Limits Exceedances: At present, the UV system is not always meeting fecal coliform limits. This problem was also noted at similar plants surveyed but operators indicated that when they improved the upstream process, the TSS concentrations in the effluent dropped and the UV system functioned properly.

Odour Control Issues: At present, the operators spend a lot of time ensuring that the odour control system is working well. However, based on the varying and inconsistent operation of the liquid train, it is difficult to adjust the operation of the solid train odour control system to suit the changes. Once the liquid train has been optimized and treatment is more consistent, this may reduce the concerns with the odour control system. Optimizing the odour control system can be investigated at that time.

As noted, the plant systems and their proper functioning are inter-twined. Many issues will likely be either reduced or resolved once the proposed upgrades at the plant are implemented, the plant operation has been optimized, and the by-laws have been in effect for a while.

3. Work Plan

3.1 Upgrades

A series of related sub-projects were identified which need to be undertaken to ensure the plant operations are flexible and the plant can meet current regulations.

Headworks Upgrades - Detailed Design, Construction and Commissioning

In general, work related to this task would include:

- Influent Screen Optimization: Optimization of the headworks influent operation.
- Equalization Tank Addition. It is recommended that an equalization (EQ) tank be installed upstream of the headworks screens to attenuate incoming plant flows. Currently, the only influent plant flows are from the Prowse pump station which collect all the Town's flows at the bottom of the hill and pump the wastewater backup to the WWTP. The flow rate of the Prowse pumps is being limited to prevent the headworks from being overwhelmed; however, the pump operation is very inefficient and resulting in excess power consumption.
- The Prowse Pumping Station Review, completed by others at KWL, resulted in the recommendation to divert two gravity mains directly to the WWTP, reducing pumping costs and to optimize the Prowse pump system operation to reduce operating costs. (Note funding is not being requested for the pump station upgrades). Once these upgrades are completed, there will be three wastewater lines discharging into the plant.
- An EQ tank will be even more critical to ensure the pumped flows from the Prowse Pump Station and the gravity lines which will feed directly into the plant are attenuated.

  Work related to this task would include the conceptual design, detailed design, construction and commissioning of an equalization upstream of the headworks.

SBR Upgrades - Detailed Design, Construction and Commissioning

In general, work related to this task would include:

- **Uneven flow splitting:** Uneven flow splitting has been experience by other ICEAS plants potentially due to a turbulent influent flow regime. Operators at both the Sooke and Port Hardy wastewater treatment plants have ended up using slightly different weir levels, sometimes as little as 6mm, to achieve equal flow split.

  Based on experience at other plants, adjusting the weirs to slightly different elevations might be warranted to achieve optimal flow splitting in the Gibsons plant.

- **Improving WAS Wasting Rate:** This would include waste activated sludge system piping changes and the addition of flow meters to allow flow pacing of the chemicals. Programming changes would also be required.
- **Modifying SBR Control System Programming:** SBR programming changes would allow for more operator control; a sub-contractor from Calgary would be hired for this portion of the work. The cost for the sub-contractor has not been included in our fees.
- **Recycling Activated Sludge:** Piping modifications to allow a portion of the WAS to be recycled at the front of the treatment system. This would allow for nitrification and more consistent and improved plant performance.
- **Automating Polymer Addition:** This would involve controlling the polymer pump rates based on the WAS flow rate via a compound loop control in the SCADA system. This change would improve thickener performance, likely reduce chemical polymer costs and reduce operational issues related to low dissolved oxygen and resulting odour in the digester.

Chemical System Addition

Based on experience at similar plants and informal trials by the Town's operators, three chemicals will be tested formally:

1. Lime ($Ca(OH)_2$);
2. Soda ash (Na_2CO_3); and
3. Caustic soda (NaOH).

Chemical addition will be optimized based on sampling results. A permanent dosing system will be designed. The space required for chemical storage and the dosing system will ultimately depend upon the chemical selected. This system could potentially be housed in the old administration building but a more detailed analysis of required storage space and ease of transforming the building is needed. For budgeting purposes, it is assumed that a new building will be required.

Increasing the alkalinity in the bioreactors will likely improve both the plant ammonia-nitrogen removal rate, allowing it to consistently meet its permit requirements, and solids dewatering capability (biological floc is more stable at higher pH).

Solids System Re-Assessment

Once the SBR Upgrades and Chemical System Addition are complete and the Operators have had a chance to work with the new system and fine tune the operation, the Solids System should be re-assessed to determine if there are any outstanding issues related to the solids stream and odour control. Based on our WWTP survey, many problems disappeared at other plants or were reduced once the liquid train was optimized.

A short technical memo summarizing plant improvements and recommendations for further upgrades to the solids system would be prepared.

3.2 Schedule

It is assumed that funding would be confirmed by the start of 2016. Consequently, the timelines for work have been generally delayed compared to the 2015 proposal to potentially take advantage of funding.

In addition, the tasks have been grouped to minimize costs. It has been assumed that the major constructions works for the Headworks EQ tank and the Chemical Building will take place concurrently, whereas the minor piping and programing upgrades for the SBR will take place at an earlier date.

Refer to Table 3-1 for a summary of works in the following years.

Table 3-1: Preliminary Schedule

Item	Upgrade	2016	2017	2018	2019
1.	Headworks Upgrades	Screens Optimization	EQ Tank Conceptual and Detailed Design	Construction	
2.	SBR Upgrades	Detailed Design	Construction		
3.	Chemical System Addition	Chemical Trials	Building Site Options Conceptual and Detailed Design	Construction	
4.	Solids System Re-Assessment				Study (6 to 8 months after Items 2 and 3)

3.3 Costs

A Class D (+75/-25%) capital cost estimate is presented in Table 3-2 for the potential upgrades at the plant identified as part of the 2014 audit. A contingency of 30% is being used for estimated budgets and estimated capital costs.

Any programming changes related to the headworks screens will be undertaken at part of the SBR construction.

Engineering budgets were estimated separately as there are several studies and evaluations which are required before design can start. These are the headworks screen optimization study, chemical trials, chemical system location evaluation (new building or building re-use). The intent of these tasks is to optimize designs and reduce capital costs wherever possible.

An inflation rate of 5% for 2016 and 3% for the following years has been assumed except for the 2019 study as the 30% contingency will likely cover the inflation rate.

Table 2: Preliminary Cost Estimate

Task	2016			2017		2018		2019
	Studies	Eng. Costs	Capital Costs	Eng. Costs	Capital Costs	Eng. Costs	Capital Costs [1]	Studies
Influent Screens Assessment	$ 9,600							
EQ Tank Conceptual Design				$ 11,700				
EQ Tank Detailed Design				$ 57,000				
SBR Design		$ 22,500						
SBR Construction/Comm.					$ 86,100			
Chemical Trials	$ 34,790		$ 5,000					
Chemical Bldg. Design, incl Geotech				$ 95,200				
EQ Tank & Chem. Bldg Construction Admin/Construction/Comm.							$ 988,400	
Solids System Re-Assessment								$ 15,900
SUB-TOTAL	**$ 44,390**	**$ 22,500**	**$ 5,000**	**$ 163,900**	**$ 86,100**	**$ -**	**$ 988,400**	**$ 15,900**
Contingency (30%)	$ 13,317	$ 6,750	$ 1,500	$ 49,170	$ 25,830	$ -	$ 296,520	$ 4,770
Inflation [2]	$ 2,885	$ 1,463	$ 325	$ 17,046	$ 8,954	$ -	$ 141,341	$ 2,274
TOTAL	**$ 60,592**	**$ 30,713**	**$ 6,825**	**$ 230,116**	**$ 120,884**	**$ -**	**$ 1,426,261**	**$ 22,944**
YEARLY TOTAL			**$ 98,130**		**$ 351,000**		**$1,426,261**	**$ 22,944**
TOTAL, EXCL. TAXES	**$1,898,335**							

Notes: 1. EQ Tank and Chemical Building capital costs based on recent projects, similar in size.
2. Inflation rates as follows: 2016 = 5%, 2017 = 8%, 2018 and 2019 = 11%

In summary, the funding request is focused on attenuating influent flows, minimizing headworks bypasses, improving the biological process in the SBR reactor, and monitoring the impact on the overall system performance, particularly improvements in meeting permit levels for effluent TSS, ammonia-nitrogen and fecal coliform. A continuous and steadier flow stream into the WWTP will result in improved treatment of a greater volume of wastewater than is currently the case.

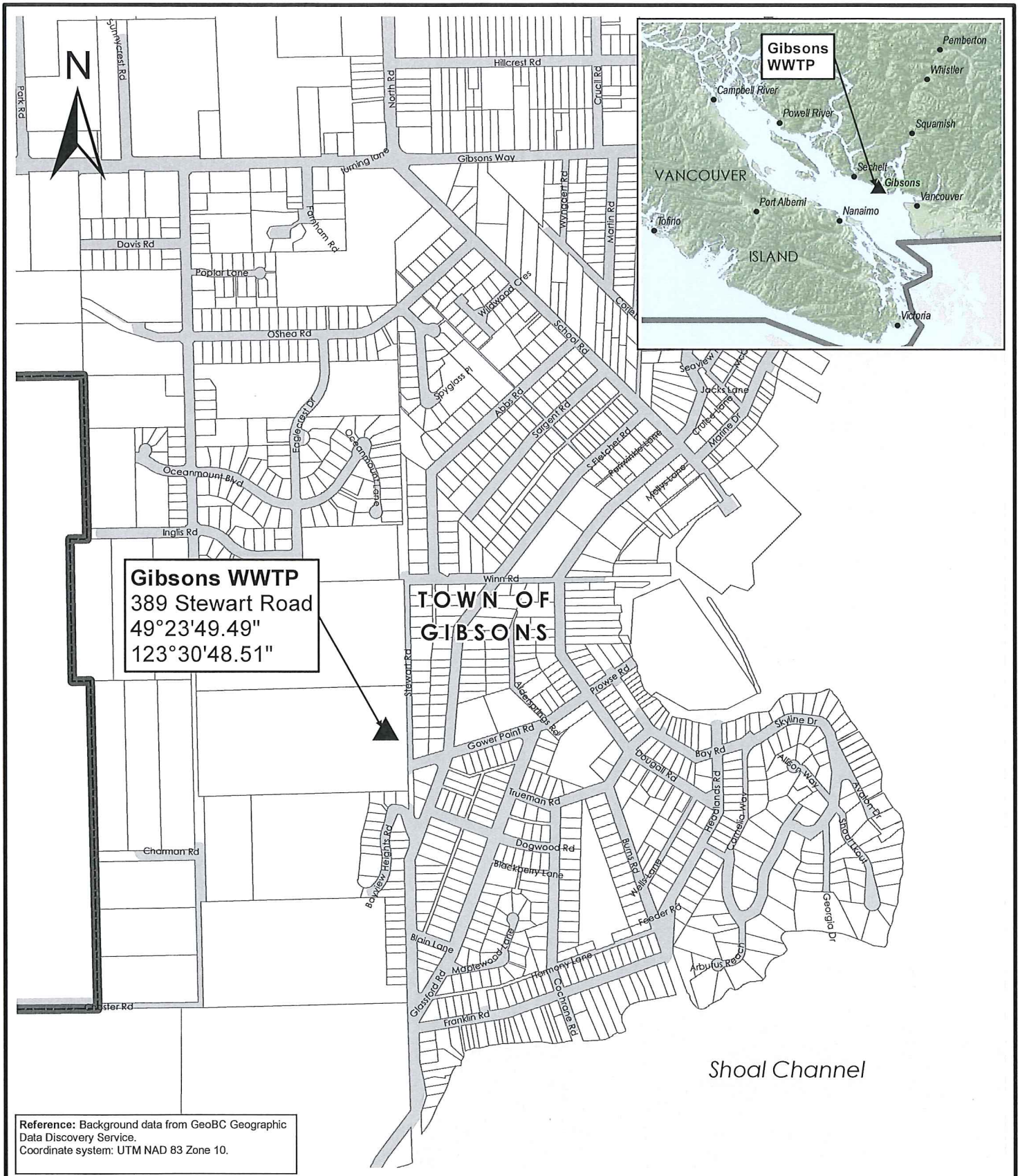
Respectfully submitted,

KERR WOOD LEIDAL ASSOCIATES LTD.

Karen Sutherland, M.Eng., P.Eng.
Project Manager

KAS/sk

Encl.



Reference: Background data from GeoBC Geographic Data Discovery Service.
Coordinate system: UTM NAD 83 Zone 10.

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Town of Gibsons

Project No.	Date
2132-017	January 2015

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Gibsons WWTP Location

Figure 1

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