Making a difference...together

REPORT TO GANGES SEWER LOCAL SERVICE COMMITTEE
MEETING OF FRIDAY 14 AUGUST 2009

SUBJECT **GANGES SANITARY SEWER MODEL SUMMARY**

PURPOSE

To inform the Ganges Sewer Local Service Committee (GSLSC) of the sewer model summary and conclusions.

BACKGROUND

The purpose of creating a sewer model is to provide a review of the existing system conditions by constructing a computer model, which establishes system capacities based on existing sizes and grades of pipe. The unknown condition of the Ganges sewer system prompted the GSLSC to commission a sewer model capable of determining problem areas such as system bottlenecks caused through increased development in certain areas. The GSLSC has tabled all requests until such time that the model had been developed and can provide for an evaluation of necessary upgrades and a basis of consideration for possible cost charges against lands taken into the area where downstream upsizing may be needed to accommodate their additional volumes.

In 2009 Stantec Engineering (Stantec) was retained to undertake the works with water consumption information and flow characteristics provided by Capital Regional District (CRD) staff. Results of the sewer model project are provided in a report (Attachment1) and technical memo on model calibration (Attachment 2).

Stantec utilized SANSYS civil systems for the modeling and populated the program with the supplied average Single Family Equivalent (SFE) water consumption rates (North Salt Spring Waterworks data) and specific water volumes from the larger commercial and institutional properties in the sewer area. Consideration was also given to densification of strata properties and commitments made in past inclusions, not yet built out (Three Point Properties). Measured flows through the treatment plant were used to balance the model to provide a suitable level of comfort when predicting the potential impact that a future development, or land inclusion, may represent.

Stantec concludes that the Ganges sewer structure is operating within acceptable levels still with a significant amount of spare capacity in the pipes with the current wet weather sewer loading. There are however, three sections of pipe identified that are currently running at >50% flow during peak wet weather flow, and seven sections >40% flow during the peak flows. These sections may need to be upsized to accommodate larger developments and inclusions in the future.

ALTERNATIVES

1. That the GSLSC receive this report for information.

2. That the GSLSC refer this matter back to staff for more information.

FINANCIAL IMPLICATIONS

The modeling process was successfully completed at a cost of approximately $23,500, and within the GSLSC approved $30,000, leaving approximately $6,500 in the project budget. Future inclusions into the sewer area may be evaluated to determine whether capacity is available through the modeling process, and the model can be used to identify the needs for upgrades to accommodate the additional flows.

SUMMARY

The Ganges sewer model is now complete and can be used as an effective tool in determining the impact that a land inclusion might have on the system, identifying the need to upsize downstream pipes in order to handle added volumes.

The sewer model was balanced (input plus minor variables versus plant discharge), to provide a discrete tool to aid staff in determining what capacity is available in specific areas of the service area and any potential "pinch points" that an inclusion may create. The model remains fluid in nature and can be used to provide recommendations to the GSLSC regarding outstanding and future inclusion requests on an individual basis.

RECOMMENDATION

That the GSLSC receive this report for information.

Gary Pleven, AScT
Engineering Technician 5

GP:ls
Attachments: 2

Attachment 1

Stantec

Sanitary Sewer Modelling Study Village of Ganges Saltspring Island, B.C.

Prepared for:
Capital Regional District

Prepared by Alan Ghanam
P.Eng

May 2009

Table of Contents

LIST OF FIGURES:

1.0 Introduction

1.1 PROJECT BACKGROUND AND OBJECTIVES

The Capital Regional District recently retained Stantec to conduct an investigation into the current sewer capacities and loadings for the Village of Ganges on Saltspring Island, B.C. The objective was to produce a zoning based 'Sanitary Sewer Model' (SSM) established with GIS information. The SSM encompasses the entire Ganges sewer system that extends from the Brinkworthy Road Trailer Park at the northern end of the village southerly to Drake Road. The western and eastern boundaries are Atkins Road and Ganges Harbour respectively.

The purpose of creating the Sanitary Sewer Model is to provide a review of the existing conditions for the Ganges sewer system by constructing a digital model using the SANSYS modeling software. The software will establish system capacities based on existing pipe sizes and grades, and will then analyze the current flows within the system based on existing conditions in the system. The model will also be capable of determining problem areas such as bottlenecks and overloading due to potential increased development in certain areas. Regular updating of the model will allow the Capital Regional District's Operations Division to confirm current system deficiencies and to predict future design and operational requirements.

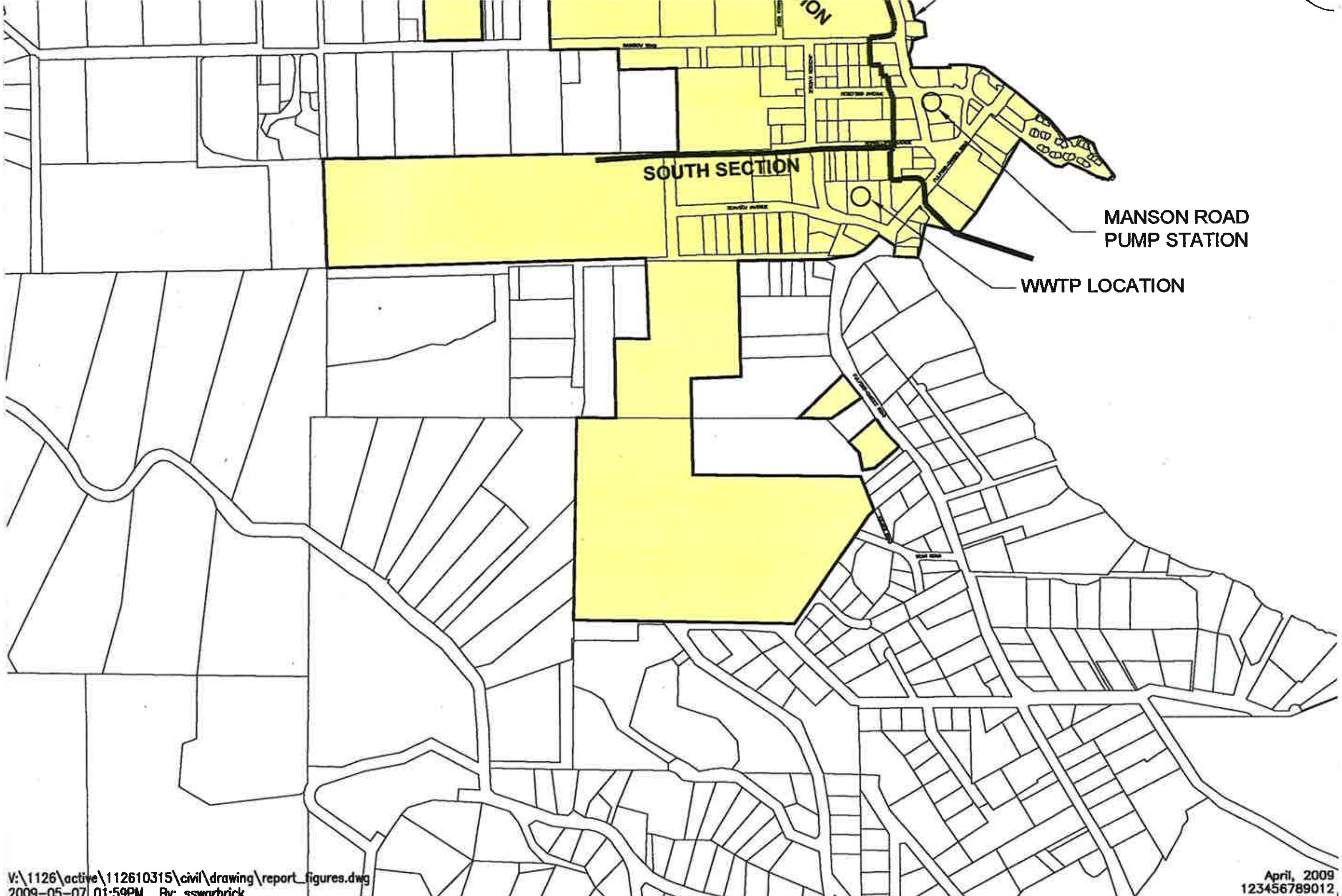
1.2 SCOPE OF WORK

The scope of work for this project includes the completion of the following works:

- A review of existing sanitary sewer infrastructure for the Village of Ganges including GIS information obtained from the Capital Regional District.
- A review of the Official Community Plan along with current legislation, bylaws, regulations and design criteria.
- Develop a Sanitary Sewer Model using existing conditions to calculate loads.
- Provide results for the Sewer Model in the form of a spreadsheet and graphical representations and highlighting any areas of concern.

1.3 SANSYS SOFTWARE

SANSYS is a program which uses data relating to pipe properties, zoning classifications, population densities, industrial densities, contributing areas and infiltration allowances to determine the required pipe sizes for a new sewerage system, or to examine the capabilities and current conditions within an existing system. SANSYS is a useful design tool for land development as changes in zoning, and the effects those zoning changes can have on the sewer system can be quickly and easily evaluated. SANSYS is also useful as a maintenance management tool, as pipe and manhole inspections may be recorded and colour coded to help prioritize any infrastructure upgrades.



V:\1126\active\112610315\civil\drawing\report_figures.dwg
2009-05-07 01:59PM By: sswarbrick

April, 2009
123456789012

ORIGINAL SHEET – ANSI B

Stantec Consulting Ltd.
400 – 655 Tyee Road
Victoria BC Canada
V9A 6X5
Tel. 250.388.9161
Fax. 250.382.0514
www.stantec.com

Legend

1:10000 — 0, 100, 300, 500m

Client/Project
CRD
GANGES SEWER MODEL

Figure No.
1.0

Title
STUDY AREA

2.0 Existing Sanitary Sewer System

2.1 OVERVIEW

The existing Sewer Specified Area (SSA) for the Village of Ganges is outlined in Figure 1 on the previous page. The majority of the properties in the SSA are serviced by gravity, and the majority of the trunk mains are sized at 200m diameter. There are some larger 250mm and 300mm diameter mains closer to the treatment plant where flows are greatest. A number of smaller 150mm diameter pipes service the smaller cul-de-sacs and side roads before connecting to the trunk mains. For the purpose of this report the SSA was split into three sections. The first section services the western area of Ganges from the Brinkworthy Road trailer park to the north, southeasterly to McPhillips Road in the south, with most properties located to the west side of Lower Ganges Road. The second section services the eastern area of Ganges from Crofton Road to the north to Seaview Road in the south. Most properties in this section are located to the east of Lower Ganges Road. The southern section services all properties south of the McPhillips Road. All sections flow to the Ganges Sewage Treatment Plant located on Seaview Road.

There are two areas serviced by pump stations that connect to the gravity system through forcemains. The first of these stations is called Harbour House Pump Station and is located on Upper Ganges Road approximately 200 meters northeast of Lower Ganges Road. The station receives flow from a hotel, two pubs, a marina and 15 townhouses. The 75mm forcemain connects to Manhole LOWGAN25 (see Figure 3: General Plan in Appendix A) on Lower Ganges Road. The second pump station is called Manson Road Pump Station and is located in the main parking area of the village commercial center. Flow to the pump station is generated mostly from businesses such as local retail outlets, a grocery store, restaurant and an office building. Its 75mm forcemain connects to LOWGAN31 on Lower Ganges Road.

All flow enters the Ganges Pump Station located within the treatment plant compound on Seaview Road. The sewage is then lifted into the treatment facility.

The flow from the treatment plant is discharged via a deep sea outfall 5km from the shores of Ganges Harbour/ Captain's Passage.

Figure 4, also included in Appendix A, shows the existing pipe diameters of the Ganges sewer system.

3.0 DESIGN CRITERIA

3.1 GENERAL

In developing a sanitary sewer model for the Ganges area, Stantec gathered information from various sources to correctly construct and load the model and used the following reference materials:

- GIS data on the existing system supplied by the CRD, including manhole locations, invert elevations, pipe diameters and pipe bends.
- B.C. Sewerage System Standard Practice Manual Version 2.

3.2 INFORMATION PROVIDED

The CRD provided GIS information to be imported into Autodesk Land Desktop software for use by Stantec when constructing the model. The information provided included the following:

- Manhole locations and invert elevations.
- Pipe diameters, pipe materials, type of pipe (gravity of pressure), locations of vertical bends in pipes.
- Legal information including public R.O.W's and property lines.
- Pump Station locations.

3.3 MODELLING ASSUMPTIONS

There were numerous areas where the information provided was incomplete and the information not attainable. In these cases, assumptions had to be made based on the local conditions to ensure the model was as accurate as possible.

- The invert information for some manholes was missing. In these cases, the invert elevations were estimated based on the upstream and downstream invert elevations.

Other assumptions and techniques needed to be employed in order to make the model operational. These assumptions are listed below:

- Vertical bends in the pipes were modeled using "dummy" manholes to simulate the start and end of the vertical curves, with each manhole being assigned no head loss through it. The slope of the pipe in between the dummy manholes is defined as the average slope of the pipe over the length of the vertical curve.

- As information regarding the service pipes from each property has not been provided, the system has been loaded by judging which trunk main each property service will connect to and then loading the corresponding upstream manhole with the appropriate population based on the number of lots and zoning classification of the connecting services. The upstream manhole is loaded to ensure that the model is considering the "worse case scenario" in terms of maximum flow through the pipe, and therefore there is a factor of safety inbuilt when sizing the pipes within the system.

- The outfall of the system has been assumed to be the inlet of the WWTP. The deep sea outfall has not been included in this analysis.

3.4 DESIGN FLOWS/POPULATION DENSITIES

As the Island of Saltspring does not have specific guidelines concerning sanitary flows per capita or by zoning classification, alternative guidelines were used to predict the existing flows. The B.C. Sewerage System Standard Practice Manual has a comprehensive list of design flows for various uses, and this was adopted as the guideline for the loading of the model.

The following is a summary of the design criteria used when loading the Existing Condition model:

a) Design Flow Allowances:

   i. Per capita flow of 300L/day

   ii. Infiltration Rate of 45L/mm diameter/day

b) Population Densities (Residential):

   i. Low Density (Single Family Lots): 3 persons per lot (the Police Station and Legion have also been included in this category, given the lack of information involving number of employees etc.)

   ii. Multi-family (townhomes/apartments/senior housing): 2 persons per lot

   iii. General Commercial (unknown use): 3 persons per lot

c) Design flows (others):

   i. Hotel: 366L/day/room

   ii. Gas Station Island: 2,000L/day

   iii. Supermarket: 3L/day/m2

   iv. Swimming Pool: 14L/day/customer (loading based on Manager estimate of 500 customers/day)

v. Pub: 125L/day/seat (loading from Moby Dick Pub based on Manager estimate of 125 seats)

vi. Launderette: 1,135L/day/machine (6 machine launderette assumed in marina area)

As per the direction of the CRD, the model was loaded with the existing conditions in the Ganges area, so no possible subdividing of the existing lots was considered.

An issue was also identified with the loads coming from the commercial lots in the downtown core. As no detailed information is known as to the specific use of each commercial lot, a flow of 900L/day, equal to 1 Single Family Equivalent (S.F.E), has been applied to each lot. The flow from commercial lots vary significantly depending on their use, with much larger flows than 1 S.F.E coming from launderettes, coffee shops, restaurants etc. The model can be updated accordingly, but more information regarding the use/number of employees/number of customers etc. for each lot would need to be gathered.

A spreadsheet detailing the loads applied to each manhole is included in Appendix B.

3.5 MODEL CALIBRATION

During the preparation of this report, no pumping records were reviewed by Stantec to assist in calibrating the peak flows for the existing condition model. If more accurate simulation was required by the CRD, it is recommended that a pump station flow test at all pump stations in the system be conducted during dry and peak flow periods.

4.0 Model Results Summary

The model was then solved using the design criteria and modeling assumptions detailed in the previous section. The findings were in keeping with the expected results for the system, in that there was still a significant amount of spare capacity in the pipes with the current loading. Sanitary systems are conventionally designed to accommodate the flows in the system which would be present if the area was developed to capacity as per the current OCP at the time of the design. At this time, there is still a large potential to subdivide many of the lots in the Ganges downtown area, and as a result, there is still significant capacity in the existing system to accept additional flow. A summary of the results as well as a spreadsheet detailing the loading applied to the model is included in Appendix B.

Figure 5 in Appendix A is a graphical representation of the current flows in the system, and is represented as a percentage of the pipe capacity. This figure is a useful tool as it can be used to predict possible problem areas for the future by analyzing and highlighting the areas in which the flow is highest as a percentage of the pipe capacity. If the model is regularly updated, the CRD could use it to plan system upgrades efficiently and timely.

Figure 3 in Appendix A is a General Plan of the model with the assigned Manhole names shown. This general plan is for use with the loading spreadsheet and results analysis spreadsheet.

Figure 4 in Appendix A provides a graphical representation of the various pipe sizes in the system. This figure illustrates a problem within the system at two locations, at manhole CROFT01 and PARK01, whereby a downstream pipe size is smaller than its upstream predecessor. In these cases, a 200mm diameter pipe is followed in the system by a 150mm diameter pipe, and in both cases, the pipe returns to a 200mm within two pipe lengths. This is currently causing no flow problems, as the system is operating at well under capacity. However, this design goes against good engineering practice and could cause issues in the future. The CRD should make these smaller pipes a priority for upgrading when any upgrades are made to the system.

The analysis of the model shows that none of the pipes are currently operating at more than 50% capacity. It is suggested that the CRD regularly update the model with current lot information to ensure system maintenance and upgrade issues can be identified early and dealt with accordingly.

STANTEC CONSULTING LTD.

COMPILED BY:
Shaun Swarbrick
Civil Engineer in Training
Tel: (250) 389-2389
Fax: (250) 382-0514
shaun.swarbrick@stantec.com

REVIEWED BY:
Al Ghanam
Senior Associate
Tel: (250) 389-2347
Fax: (250) 382-0514
alan.ghanam@stantec.com

Attachment:

Attachment 2

Stantec

Ganges Village Sanitary Sewer Model

Report Updates

Prepared by Alan Ghanam, P.Eng

Stantec
GANGES VILLAGE SANITARY SEWER MODEL
REPORT UPDATES
CRD
AUGUST 2009

This technical memorandum is intended as an update to the original Ganges Village Sanitary Sewer Model Report, submitted to the CRD in April 2009.

Background

During the compilation of the original report, a number of assumptions were made concerning the loads which were applied to the SANSYS model for the various lot uses and sizes within the Sewer Service Area (SSA). These assumptions were based on good engineering practice and guidelines set out in the BC Sewerage System Standard Practice Manual. The CRD requested the SANSYS model be updated according to actual recorded data in the area. Typical water consumption for Single Family Dwellings were obtained by the CRD by taking water meter readings from a number of dwellings in the Ganges Village area; and taking the average of those readings. Other significant contributors to the sanitary flow in Ganges include Roscommon and Kingfisher Cove strata developments, the Harbour House Restaurant/Hotel, the Ganges Marina, Moby's Pub, the Gulf Islands Secondary School on Rainbow Road, Thrifty's Foods and Ganges Village Market. Water consumption rates for these sites has been provided by the CRD to Stantec, and the new flows have been input into the original SANSYS model.

Conceptual Design Parameters

The design parameters used for this technical memo are based upon actual water consumption rates recorded at the property water meters by the CRD over a period of one year in 2007. It was decided through discussion with members of the CRD and Stantec. For the purposes of the SANSYS modelling, that it will be assumed that 100% of the water consumed for each lot will enter the sanitary sewer system. The numbers used to load the model were those from the months when the water consumption was highest i.e. during the summer months, to ensure the model simulates the highest flows in the system during the year.

The flows for each lot can be summarized below:

- Residential sanitary sewer generation:
  - Single family residential 862L/day/residence
  - Kingfisher Cove Strata [redacted]L/day/residence
  - Roscommon Strata [redacted]L/day/residence
- Other significant contributors:
  - Harbour House Hotel/Restaurant [redacted]L/day
  - Ganges Marina [redacted]L/day
  - Moby's Pub [redacted]L/day

- High School [redacted]L/day
- Thrifty's Foods [redacted]L/day
- Ganges Village Market [redacted]/day

MODELLING RESULTS SUMMARY

The model was rerun with the revised flows for each SFE (Single Family Equivalent) dwelling in the SSA and the other significant contributors to the sanitary flow from the Ganges Village area. These changes to the loading parameters from the original model conditions have inevitably increased the sanitary flow into the WWTP on Seaview Avenue. Although the flow from the SFE lots have decreased slightly (from 900L/day/residence in the original model to 862L/day/residence in the updated model), there have been other lots where the flows applied to the model have drastically increased; in particular the loadings from the high school and Thrifty's Foods.

An updated graphic representation of the flows through the pipes in relation to their capacities (Figure 5, Rev1) is included in Appendix A. The peak flow recorded in the model at the inlet to the WWTP is 28.8L/s. This number includes the peaking value derived from Harmon's equation. In order to evaluate the accuracy and reliability of the model, it is necessary to compare the actual recorded results at the outfall of the system (assumed in this case to be the inlet to the WWTP) with those predicted by the model. The average wet weather flow predicted by the model at the WWTP inlet is 8.7L/s, which is equivalent to 751.68m^3/day. The CRD provided a spreadsheet detailing the flows recorded at the WWTP inlet daily for October 2007 to October 2008, with a wide range of results recorded. The largest reading recorded was 1039m^3/day, recorded on December 4th, 2007. This date is closely followed by two other high readings, which suggest that this was a time of unusually heavy rainfall, and therefore unusually high Inflow and Infiltration likely accounts for these results. Throughout the majority of the spring and summer months the average daily readings at the WWTP are in the region of 400 to 500m^3/day. During the wetter fall and winter months from October to February, the daily volumes range from 500m^3/day (presumably on dry days) to 800m^3/day on the wetter days.

To further breakdown the calculation process, the model predicts wet weather flows of 750m^3/day. This quantity is in the upper region of the actual volumes recorded at the WWTP. This is to be expected because when loading the model, the peak flows recorded at the water meters for the significant contributors to the system (the High School, Moby's Pub etc.) were typically taken in the summer months around July/August. When SANSYS calculates the peak flows in the system, the flows from each of the lots is based on summer water meter readings. However, the Inflow and Infiltration values are based on wet weather conditions. As a result, the model predicts flows which are slightly above what would typically be experienced in the actual system. The high I and I rates will typically not coincide with the times of high water consumption. However, it should be noted that although higher than anticipated flows will be predicted in the model due to the summer commercial flows being used for loads, it should be assumed that the hotel/marina/restaurants could still be full during the winter season and therefore still provide the same volumes of flow during the wet season as during the dry season. It is therefore important that this scenario is considered during modelling to predict the performance of the system during a high flow event.

The flows as predicted by the model are presented in a spreadsheet in Appendix A.

STANTEC CONSULTING LTD.

COMPILED BY:
Shaun Swarbrick
Civil Engineer in Training
Tel: (250) 389-2389
Fax: (250) 382-0514
shaun.swarbrick@stantec.com

REVIEWED BY:
Al Ghanam
Senior Associate
Tel: (250) 389-2347
Fax: (250) 382-0514
alan.ghanam@stantec.com

Attachment:

ap v:\1126\active\112610315\civil\report\tech_memo_090810\techmemo_ss_20090810.doc

Stantec

Stantec Consulting Ltd.
400 - 655 Tyee Road
Victoria BC Canada
V9A 6X5
Tel. 250.388.9161
Fax. 250.382.0514
www.stantec.com

Consultants

Legend

Notes

Revision | By | Appd. | YY.MM.DD

1. ISSUED FOR TECHNICAL MEMO | SS | AC | 09.08.10

Issued | By | Appd. | YY.MM.DD

File Name | Dwn. | Chkd. | Dsgn. | YY.MM.DD

Permit-Seal

Client/Project
CRD

GANGES SEWER MODEL

Victoria BC Canada

Title
CURRENT PEAK WET WEATHER FLOWS
% PIPE CAPACITIES

Project No. 112610315
Scale 1:2500 0 25 75 125m

Drawing No. Fig 5
Sheet 5 of 5
Revision 1

N
LOWER GANGES ROAD
CROFTON ROAD
CORBETT ROAD
VALHALLA DRIVE
LOWER GANGES ROAD
DESMOND CRESCENT
SWANSON ROAD
PARK DRIVE
VILLAGE TERRACE
LAKEVIEW CRESCENT
PARK DRIVE
KANAKA ROAD
RAINBOW ROAD
FULFORD-GANGES ROAD
WWTP LOCATION
SEAVIEW AVE
INSET VIEW: SOUTH SECTION