MEMORANDUM

URBAN systems

Date:	July 6, 2012
To:	Jenni Chancey, District of Squamish
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From:	Peter Gigliotti, Urban Systems
File:	1928.0005.01
Subject:	Technical Memorandum #2 – Wastewater Treatment

This technical memo is intended to serve as a background report on the District of Squamish Wastewater Treatment Plant, named the Mamquam WWTP. The memo is derived from an examination of plant flow and testing records and review of the following documents: the Ministry of Environment Discharge Permit; Technical Memorandum by Kerr Wood Leidal, Consulting Engineers, dated January 24, 2012, entitled *Mamquam Treatment Plant Capacity and Risk Assessment;* the District of Squamish Official Community Plan (2009); Kerr Wood Leidal *Public Works Asset Management Plan* dated January 2011, and Statistics Canada and BC Stats population publications.

1. TREATMENT PLANT OVERVIEW

The Mamquam WWTP was originally constructed in 1973, with a second plant servicing south Squamish. An upgrade in 1996 resulted in expansion of the Mamquam WWTP. By 2006, all flows from South Squamish were diverted to the Mamquam WWTP and the southern plant was decomissioned.

A further upgrade and expansion was undertaken in 2006 resulting in a double train of process units. The current plant operates under the provisions of a Ministry of Environment Discharge Permit (#PE-01512), amended April 5, 2001.

The plant utilizes two trains, with both trains having screening and grit removal, activated sludge bio-reactors, and secondary clarifiers. Disinfection is not practiced at this plant. Residual sludge is processed by thickening using Dissolved Air Flotation (DAF) and dewatered using a solid bowl centrifuge.

The treated effluent discharge is to the Squamish River through a submerged outfall pipe. The dewatered sludge is hauled to Whistler for further processing.

The key effluent quality parameters in the Discharge Permit (stated as maximum allowable conditions) are as follows:

- Biochemical Oxygen Demand (BOD_5): 30 mg/L
- Total Suspended Solids (TSS): 40 mg/L
- Maximum flow: 17,850 m^3/d
- Toxicity: must pass 96 hour LT 50 fish bioassay (rainbow trout)

The sampling and testing protocol in the Discharge Permit includes the following:

LT 50 96 hr fish bioassay:	yearly (6 times per year if there are 2 consecutive failures)
Ammonia N:	monthly
BOD_5:	weekly
TSS:	weekly
Flow:	daily
Outfall inspection:	five years
Reporting (to MoE):	twice per year (March 31 and September 30)

2. WWTP COMPONENT CAPACITIES

The following rated capacities are taken from the Kerr Wood Leidal January 24, 2012 Technical Memorandum. The capacities have been tabulated for each unit process. It is assumed that the rated capacities are based on conventional design criteria for each of the unit processes. Typical design criteria are published by World Environment Federation (WEF)/ American Society of Civil Engineers (ASCE) Manuals of Practice. The capacities are given in m^3/d (cubic metres per day).

	# of Units	Train 1 Capacity (m^3/d)	# of Units	Train 2 Capacity (m^3/d)
WWTP Lift Station	3	12,200	3	4,100
Screening	1	18,000	1	18,000
Degritting	1	18,000	1	9,500
Aeration Bio-reactor	1	5,000	1	9,000
Clarifier	1	8,232	1	8,232

The overall plant capacity appears to be constrained by the rated bio-reactor capacity to approximately 14,000 m^3/d. The Permit allows up to 17,850 m^3/d to be discharged.

3. RECORDED FLOWS

Figure 1 provides a graphical summary of recorded flows at the Mamquem WWTP for the years 2009 through 2011. Given the seasonal variation in flows, rainfall data has been added to the graphic in an attempt to discern if there is any relationship. The rainfall data is from a North Vancouver Environment Canada weather station. Since there is limited climate data available for Squamish, the North Vancouver data is used as it appears to have a similar pattern to the limited Squamish data.

4. DISCUSSION OF FLOW PATTERNS

The seasonal flow patterns evident on Figure 1 are consistent over the three year period. The Average Daily Flow Rates from May through October are similar for each year, and the effect of rainfall appears to be negligible during those periods. The average daily flow over this period is 7,200 m^3/d. This can be taken as the ADWF (Average Dry Weather Flow). The pattern shifts in November and demonstrates much higher flows from November through April. This is also a period of higher rainfall, typically peaking in December/January.

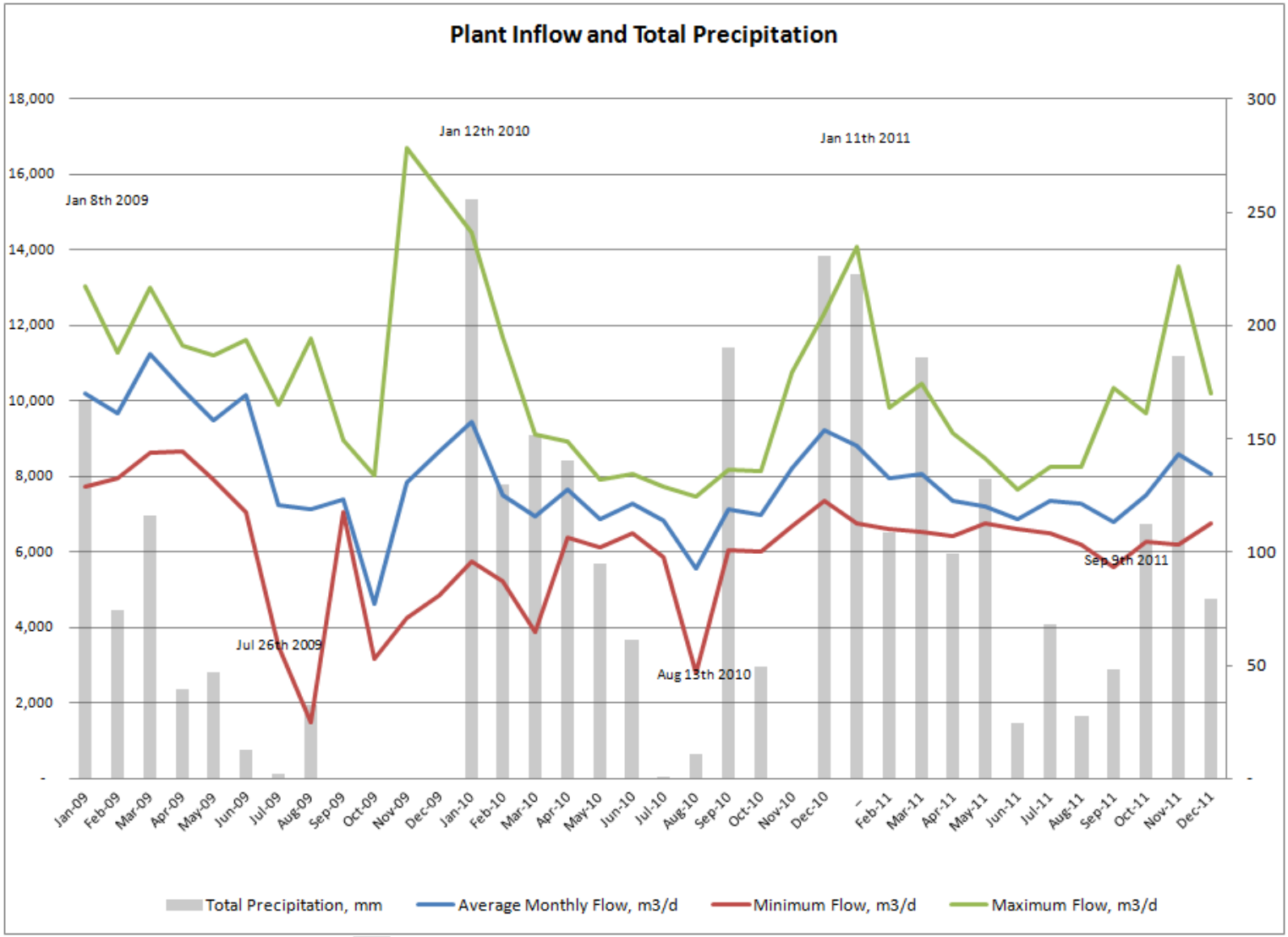
A closer examination of the dates with heavy rainfall recorded and peak flows at the plant reveals that peak flows are recorded at the plant some 3 to 5 days after the heavy rainfall event. This would indicate that the contribution of Inflow (direct connection of rainfall runoff to the sanitary system) may not be as significant as Infiltration (entry to the sanitary system because of high groundwater). The consequence of the high rainfall season may be an overall rise in the groundwater level, resulting in greater entry of groundwater through joints in pipe and manholes. The average daily flow through the wet season is 8,300 m^3/d, an increase of 1,100 m^3/d over the ADWF.

Peak daily flows after a high rainfall event reach over 14,000 m^3/d, or two times the ADWF, indicating that Inflow is also a factor in the peak flow figure. These high seasonal flows have not overwhelmed the plant operation as it is capable with the two trains to process in the order of 14,000 m^3/d. However, there is no redundancy in the bio-reactors during those periods.

5. TREATMENT EFFECTIVENESS

Figure 2 provides a plot of effluent quality parameters over the year 2011. The maximum allowable concentrations in the Permit have not been reached, although TSS levels come close to the maximum allowable during the high rainfall months of January /February. Interestingly, the influent BOD_5 during the high rainfall months is noticeably low; a further indication that significant entry of groundwater is resulting in a “dilution” effect on the sanitary sewage.

Effluent BOD_5 has remained below 10 mg/L through the year, and effluent TSS, while high in some months, has remained below the Permit maximum of 40 mg/L.


Plant Inflow and Total Precipitation
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
300
250
200
150
100
50
-
Jan 8th 2009
Jan 12th 2010
Jan 11th 2011
Jul 26th 2009
Aug 13th 2010
Sep 9th 2011
Jan-09
Feb-09
Mar-09
Apr-09
May-09
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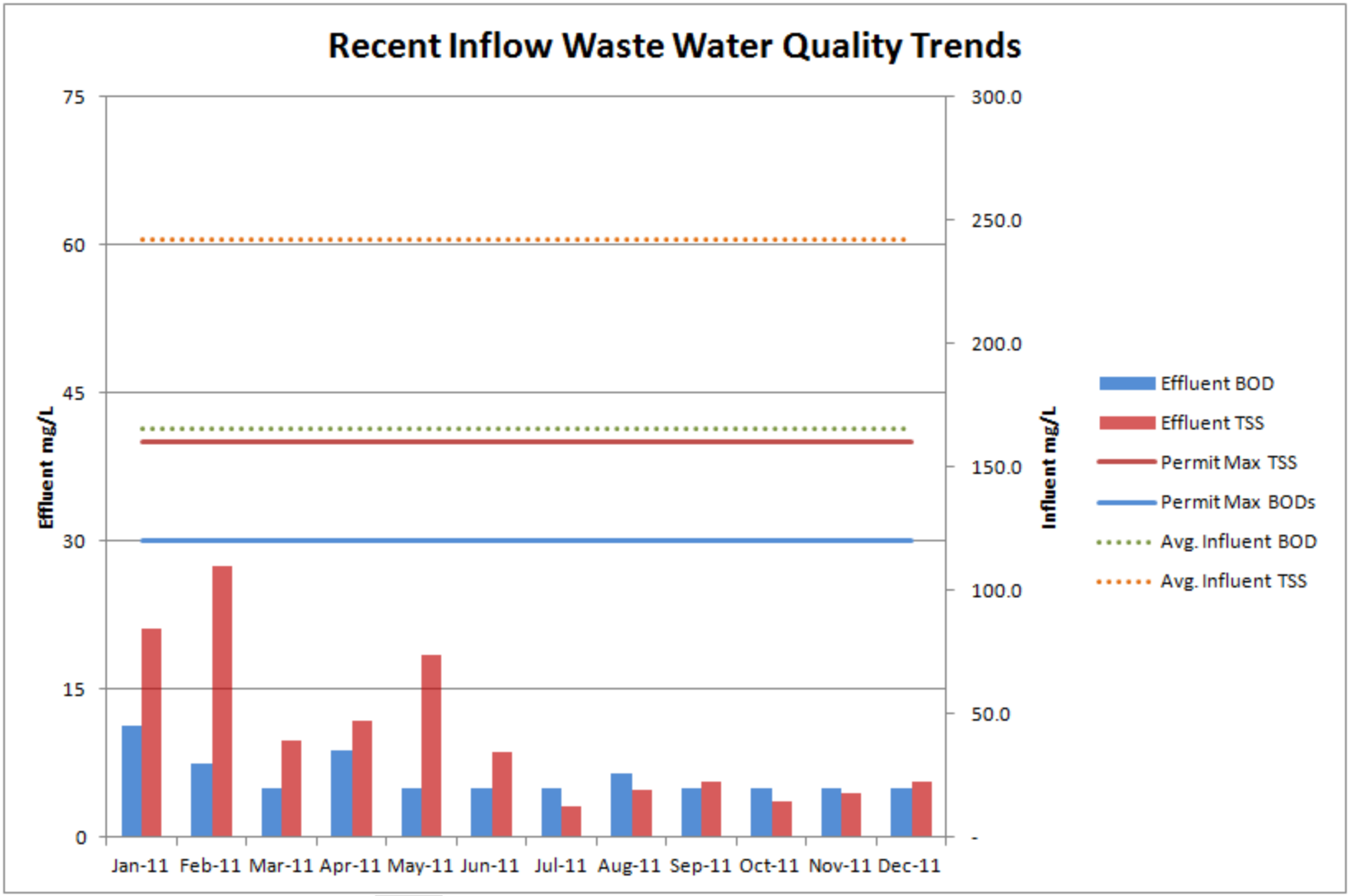
Nov-10
Dec-10
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Total Precipitation, mm
Average Monthly Flow, m3/d
Minimum Flow, m3/d
Maximum Flow, m3/d


Recent Inflow Waste Water Quality Trends
Effluent mg/L
Influent mg/L
75
60
45
30
15
0
300.0
250.0
200.0
150.0
100.0
50.0
-
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Effluent BOD
Effluent TSS
Permit Max TSS
Permit Max BODs
Avg. Influent BOD
Avg. Influent TSS

6. THE NEW STANDARDS

The BC Government has recently issued amended legislation replacing the Municipal Sewage Regulation. The new regulation is called the Municipal Wastewater Regulation, adopted on April 19, 2012 by Order in Council No. 230. The government of Canada has also published a proposed *Canadian National Performance Standard – Wastewater Systems Effluent Regulations (WWSER).*

The following table summarizes the effluent quality parameters under the Provincial BC MWR Regulations and the Canadian WWSER. The dilution ratio for the discharge is a factor in the MWR, with different allowable maximums for dilutions greater than 10:1 and greater than 40:1. There is an Environment Canada gauging station below the Squamish River, but the flow data is not available. It can be reasonably assumed that flows at that location will be greater than the Brackendale station, so the parameters for dilution greater than 40:1 have been adopted for this comparison. The low flow in the Squamish River near Brackendale for 2010 is 37.9 m^3/s. This equates to 3,275,000 m^3/d, representing a dilution of 182 times the Permit discharge allowed of 17,850 m^3/d.

	BC MWR	CAN WWSER
Carbonaceous BOD_5 (mg/L)	≤ 45 (max)	≤ 25 (avg)
TSS (mg/L)	≤ 45 (max)	≤ 25 (avg)
pH	6-9	n/a
Total Phosphorus (mg/L)	≤ 1.0	n/a
Ortho-phosphate (mg/L)	≤ 0.5	n/a
Ammonia (mg/L)	Back calculation*	< 1.25 (max)
Total Residual Chlorine (mg/L)	< 0.02	≤ 0.02 (avg)
Toxicity (LC 50) % passing	n/a	n/a
Faecal Coliform (MPN/100mL)	200	n/a

**based on chronic concentrations at end of dilution zone*

It is unclear under which jurisdiction the discharge will fall under. The most likely is the BC MWR. If that is the case, Phosphorus removal will become a requirement unless the completion of an environmental impact study indicates otherwise. The plant, under its current configuration is not equipped to remove Phosphorus. The plant will also be required to reduce faecal coliforms to meet the maximum allowable value of 200 mpn/100mL (because Squamish River is used for recreational purposes).

The plant can continue to discharge under the provisions of the current Permit. However, when the time comes for expansion, the propose discharge effluent quality will have to meet the BC MWR provisions or obtain an Operational Certificate under the provisions of a Liquid Waste Management Plan (LWMP). It is important therefore, that the LWMP deal with the issue of phosphorus removal and address the question of whether it is required for this particular discharge.

The BC MWR also has provisions for discharges in excess of the ADWF. For daily flows in excess of 2 times the ADWF, the carbonaceous BOD_5 and TSS concentrations must be less than 130 mg/L.

The allowable Ammonia concentration at the "end of pipe" must be calculated by a back calculation from the edge of the initial dilution zone that considers the ambient temperature and pH characteristics of the receiving water and the water quality guidelines for chronic ammonia.

7. THE OUTFALL

The existing outfall pipe discharges to the Squamish River to a depth approximately 1.0 m below average low water level (from Permit PE-01512). The original pipe is 400 mm diameter. A 910m additional twinning section was installed in 2006 to increase capacity. The LWMP is to review the outfall conditions and diffusion parameters.

8. THE WWTP SITE

The current site includes the WWTP and the District's Public Works yard. The site is bounded by the river dyke and the railway. Expansion of the WWTP will inevitably be required as the District grows, and the options for increased site area need to be addressed in the LWMP.

9. ISSUES AND CONCERNS

This brief overview of the WWTP operations has identified several issues and concerns that the LWMP should deal with. These include:

- The impact of inflow and infiltration on plant operations and effluent quality. Potential approaches to reducing the impact by initiatives to limit inflow and infiltration, or by pre-treatment for high flows during storm events.
- The issue of phosphorus in the discharge and its impact on the receiving water and associated habitat. An Environmental Impact Study on the receiving water will likely be required.
- The efficiency of the operation (energy consumption, labour) and the means available to increase efficiency and sustainability.
- The adequacy of the site for the long term and the options for expanding capacity in future years.
- The options for provision of disinfection in order to meet the provincial and federal requirements.
- Opportunities for beneficial re-use of treated water for industrial or agricultural purposes.
- The adequacy of current revenues to fund future expansions and upgrades as required.

The next exercise will include a long list of potential approaches to deal with these issues and concerns.

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