Besant and Associates Engineers Ltd
PO Box 47068 ~ Vancouver, BC ~ V6G 3E1 ~ www.besanteng.ca
tel : 604 990 1751 ~ fax : 604 689 4690

4 August 2011

Peter Chan
Senior Strata Agent
Vancouver Condominium Services Ltd.
400 - 1281 West Georgia Street
Vancouver, BC V6E 3J7

Dear Sir,

Re: NW 3119, Queens Gate, 8500-8580 General Currie Rd. Richmond
Domestic Water Piping Evaluation (the "Project")

The condition of the domestic water piping in Queens Gate (the "Buildings") is such that the Strata is considering replacing the domestic water piping.

We were retained to review the condition of the piping systems, to review the design of the system and to make recommendations for remediation measures based on the these findings.

In our proposal from September, 2009 we outlined the following tasks and services:
1. Meet with the Strata to review past problems with the plumbing system and obtain as much information as possible about the operation of the system and history of failures.
2. Review the building drawings, sections of failed pipe and routing considerations for the plumbing system. Analyze any available pipe samples and possibly obtain additional pipe samples from building distribution system.
3. Develop a retrofit plan and obtain pricing from contractors for the various options if required.
4. Develop a filter/water treatment system plan and obtain pricing from contractors for various options if required.
5. Prepare a letter report summarizing our findings.
6. Meet with the Strata to discuss the study findings.

Background and General History of Piping Problems in the Lower Mainland

We commonly see piping systems being replaced after 15 to 25 years of service (the first phase of the development was completed in 1989 making the piping system just over 20 years old). However, depending on how the domestic water system is operated and managed, we also see domestic water piping systems remaining in service for much longer.

Domestic water systems in large building commonly have recirculation pumps. The pumps constantly circulate hot water through the piping in the building so that residents do not have to wait for hot water to reach their taps (commonly, water travels at a speed of 5 to 8 feet per second in domestic water piping and therefore it can several minutes for hot water to reach the fixtures without a recirculation pumps in large buildings). The problem with this is that circulating hot water causes corrosion in the pipes much more rapidly than would be the case if the water was not circulated 24 hours per day, sever days of the week.

The lower mainland has had the reputation for having some of the worst plumbing problems in North America. Our water is naturally acidic (i.e., low pH) and soft (i.e., lacking in mineral content). These conditions are the result of where our water comes from. Our water is primarily run-off water stored in granitic basins for relatively short periods of time as result it has a low mineral content and high levels of dissolved oxygen and carbon dioxide (whereas water in contact with limestone would tend to have higher levels of dissolved carbonates). Further, dissolved oxygen is corrosive (oxygen supports the cathodic reaction in metallic corrosion). The high levels of dissolved carbon dioxide can create carbonic acid. In addition, at certain times of the year, when turbidity levels are high the GVRD must respond by increasing the concentrations of chlorine, which can also be corrosive to copper piping.

Study Findings

Strata Meeting Summary Notes

The Strata provided comments on our draft report issued in September 8, 2010. In addition, we met with the Strata on December 8, 2010 to review the draft to gather information on domestic water piping system. We have summarized the information collected from those events.

1. The Strata wanted to ensure we reviewed the past history of problems with all of the buildings in the development. They require this information to aid in their decision about which direction to take with remediation measures.

   We contacted both Vancouver Condominium Services and Service Plus Mechanical (Mr Amer) to obtain information on the history of failures in the development. The following notes came from these enquiries:
   - 8580 had the most number of problems or failures with the piping system. According to Service Plus, there were as many as 10 failures per year in this building.
   - Service Plus reported that it was common to have between 1 and 3 failures in the 8500 and 8520/60 annually.
   - While it is difficult to predict costs associated with each piping failure, the fact is that if the system has to be shut-down in order for the contractor to solder a new section of piping in place, it is at least 1 full days work. Plus, if there is drywall damage or water damage to walls, floors or ceilings, the costs are much greater. As a median value, we would expect that the cost of piping repair to be several thousand dollars (plumbing repair costs to be approximately $1,200 plus refurbishment costs which can vary greatly).

2. In addition, we were to look for sections of failed piping (if they were available) to verify the mode of failure.

   Service Plus was not able to provide any sections of failed pipe for our review. They had carefully examined sections of failed pipe and noted that wall thickness was not significantly reduced, however there were localized pin-holes with some deposition of a crystal material around the locations where there were holes. No other notable features were reported on the pipe sections removed by Service Plus.

3. We were to estimate the annual cost of repairs and to complete a cost best analysis of the various remediation measures.

   Taking the worst case scenario, which is 8580 (Building 4 on the original drawings), prior to installing the Hyteck Water Treatment System, the frequency of failure could be as many as 10 times per year. The average cost of each failure could vary significantly depending on the clean-up requirements and the location of the failure, but this analysis we have assumed that the cost of each failure would be $3,500. We constructed a simply economic model using Net Present Value to compare the cost of replacing the system versus the cost of repairing the system. The summary Excel Spreadsheet is contained in Appendix One, however we have included the basic assumptions and results here.

   For this analysis, we looked at three different scenarios: (1) in the first, we modelled the costs based on the failure rate of 10 failures per year and remaining at this rate throughout a 40 period in the service life of the building. We did not include any costs for complete piping replacement since it was assumed that a majority of the pipe would be replaced through service calls to repair leaks. In the second scenario (2), we considered the costs of replacing the complete piping system. Under this scenario, the failure rate is much lower. Finally, for scenario three (3) we considered the case where chemical treatment was installed and the resulting failure rate was greatly reduced.

   Assumptions:
   1. Failure rate is relatively constant at a maximum of 10 per year.
   2. We assumed that the average cost of each failure was $3,500.
   3. We used a discount rate of 5.0% (basically the cost of borrowing money).
   4. We estimated the cost of replacing the recirculation system from other similar projects we have worked using $250/linear foot as a budget number for pipe replacement and assumed that the recirc system would be replaced after 15 years of service.
   5. We estimated the cost of completely replacing the piping system after 20 years of service again basing our costs on other similar projects, discussions with service contractors and a budget number of $250/linear foot for pipe replacement.

   Findings
   1. Under scenario one (1) (do nothing), the net present value of the costs associated with the plumbing system is $596,000.
   2. Under scenario two (2) (replace system with PEX), the net present value of the costs associated with replacing the plumbing system is $532,000.
   3. Under scenario three (3) (add chemicals), the net present value assuming chemical treatment is used to reduce the failure rate is $144,000.

   Therefore, if we accept our assumptions about failure rate, cost of failure and discount rates, we believe that it is less expensive in the long-run to is to install a chemical treatment system.

4. We were to review the existing design and look for deficiencies or short-comings that are inherent in the

original design.

We discuss this at length in the section on the Drawing Review in this report.

5. One factor discussed during the Strata meeting was the issue of water temperatures. This is important because the operation of the building must consider the risk of scalding and the risk of Legionella. Peter Chan did some research on this topic and found minimum hot water supply temperature requirement for a dwelling unit as per 9.31.6.1 of the BC Building Code is 45 degrees Celsius.

Drawing Review Summary Notes

We have drawings for 8520/60 and 8580. We were not able to locate any other drawings. There were drawings 8520/60 on site and we located drawings at the City of Richmond for 8580.

We reviewed the drawings to compare the pipe sizes with contemporary standards and code requirements. We have the following notes based on the information we drew from the drawings.

Table 1--Comparison of Existing Pipes Sizes with Current Code and Best Practices

Pipe Size	Max Cold Water Fixture Units (existing)	Max Cold Water Fixture Units (Code)	Max gallons per minute (existing)	Maximum gallon per minute (best practice)	Max flow rate (existing) (feet per second)	Max flow rate (best practices)
1/2"	7	na	6	na	8	na
3/4"	16	16	12	6	8	4
1"	30	31	20	10	8	4
1-1/4"	58	57	32	24	8	6
1-1/2"	107	110	45	38	8	6
2"	265	265	78	58	8	6

What we see from information available on the existing drawings is that system has higher water velocities than would commonly be used at this time. This contributes to wear on the piping and fittings and may be partially responsible for some of the failures in the existing piping system. We did not note any differences in the geometry of the basic design parameters of the different buildings to account for the difference in failure rate between the different buildings.

Retrofit Plan and Budgets

As mentioned previously, we have drawings for 8520/60 and 8580. We were not able to locate any other drawings.

Based on our pricing models, we estimate the retrofit costs for each building to be as follows:
8500: $500,000
8520/60: $600,000
8580: $500,000

Water Treatment System Discussion

As noted previously, we feel that the economic case for water treatment is sound. However, embedded in this analysis are assumptions about how effective the water treatment system will be a mitigating piping problems.

Based on the first 8 months of operation, the owners have experienced a reduction in the severity and frequency of piping problems. This is a good sign. It is known that proper water treatment can reduce the effects of long-term exposure to corrosive water. We have suggested to the Strata that they monitor the situation for a period of one year beginning in July 2011. At the end of that time (JLu 2012), they need to revisit the question of piping replacement and decide if they are satisfied with the performance of the water piping.

We have also asked that the service contractor retain any sections of pipe which have been removed as result of completing repairs. These will be examined in the future to better understand how well the system is working.

Conclusions and Recommendations

This study accords to the direction taken by the Strata for remediation of their plumbing problems within this complex. We believe that the chemical treatment system can greatly reduce the failure rate of the domestic water piping and domestic water heaters. The cash flow analysis shows that the net present value of this approach is a small fraction of the net present value of either a complete piping replacement or continuing to repair problems as they occur without fixing the system.

Further, the initial indications in terms of costs and problems with the piping system is that the chemical treatment option is having an significant effect on the performance of the system. We have suggested that the performance of the piping system be closely monitored for a period of one year at which time the decision about re-piping should be revisited.

Should it be found that the rate of failures has not reduced dramatically and cost have not reduced dramatically then consideration should be given to retrofitting the entire piping system.

Best regards,

Besant and Associates Engineers Ltd.

Jeff Besant, P.Eng.

1	2	3	4	5	6	7	8	9	10	11	12	13
10	10	10	10	10	10	10	10	10	10	10	10	10
$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500
35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000
0	1	0	0	0	0	0	0	0	0	0	0	0
10,000	$3,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0	1	0	0	0	1	1	1	1	1	1	1	1
	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760
$2,500	$9,260	$5,760	$5,760	$5,760	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260
35,000	$70,000	$105,000	$140,000	$175,000	$210,000	$245,000	$280,000	$315,000	$350,000	$385,000	$420,000	$455,000
10,000	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500	$513,500
$2,500	$11,760	$17,520	$23,280	$29,040	$38,300	$47,560	$56,820	$66,080	$75,340	$84,600	$93,860	$103,120

14	15	16	17	18	19	20	21	22	23	24	25	26
10	10	10	10	10	10	10	10	10	10	10	10	10
$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500
$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000
0	1	1	1	1	1	1	1	1	1	1	1	1
$0	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500
1	1	1	1	1	1	1	1	1	1	1	1	1
5760	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760	5760
$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260	$9,260
$490,000	$525,000	$560,000	$595,000	$630,000	$665,000	$700,000	$735,000	$770,000	$805,000	$840,000	$875,000	$910,000
$513,500	$517,000	$520,500	$524,000	$527,500	$531,000	$534,500	$538,000	$541,500	$545,000	$548,500	$552,000	$555,500
$112,380	$121,640	$130,900	$140,160	$149,420	$158,680	$167,940	$177,200	$186,460	$195,720	$204,980	$214,240	$223,500

37	38	39	40
10	10	10	10
$3,500	$3,500	$3,500	$3,500
$35,000	$35,000	$35,000	$35,000
1	1	1	1
$3,500	$3,500	$3,500	$3,500
1	1	1	1
5760	5760	5760	5760
$9,260	$9,260	$9,260	$9,260
295,000	$1,330,000	$1,365,000	$1,400,000
594,000	$597,500	$601,000	$604,500
325,360	$334,620	$343,880	$353,140

Appendix Two

Domestic Water Piping Notes
8500 General Currie

Besant and Associates Engineers Ltd
PO Box 47068 ~ Vancouver, BC ~ V6G 3E1 ~ www.besanteng.ca
tel : 604 990 1751 ~ fax : 604 689 4690

Description of Existing Systems

Building 8500

No. of Units: 62

The domestic water system has recently been upgraded to include a water treatement system supplied by Hytec Water Management (604 628-2421).

Hot water is supplied by an AO Smith direct fired gas water heater with an input of 611,000 BTUH. It supplies hot water to 2 x 119 US Gallon glass lined AO Smith storage tanks. Water temperature was noted to be approximately 55° Celcius.

See Photos 1, 2 and 3.

Building 8520/8560

No. of Units: 45 units in each building for a total of 90 units all served by single domestic water heating system.

The domestic water system has recently been upgraded to include a water treatement system supplied by Hytec Water Management (604 628-2421).

Hot water is supplied by an AO Smith three (3) direct fired gas water heaters each with inputs of 611,000 BTUH. There are no storage tanks. Water temperature was noted to be approximately 55° Celcius.

See Photos 4, 5 and 6.

Building 8580

No. of Units: 70

The domestic water system has recently been upgraded to include a water treatement system supplied by Hytec Water Management (604 628-2421).

Hot water is supplied by an AO Smith direct fired gas water heater with an input of 611,000 BTUH. It supplies hot water to 2 x 119 US Gallon glass lined AO Smith storage tanks. Water temperature was noted to be approximately 55° Celcius.

See Photos 7 and 8.

Photos of Existing Systems

Photo 1--(8500) Gas fired, direct water heater

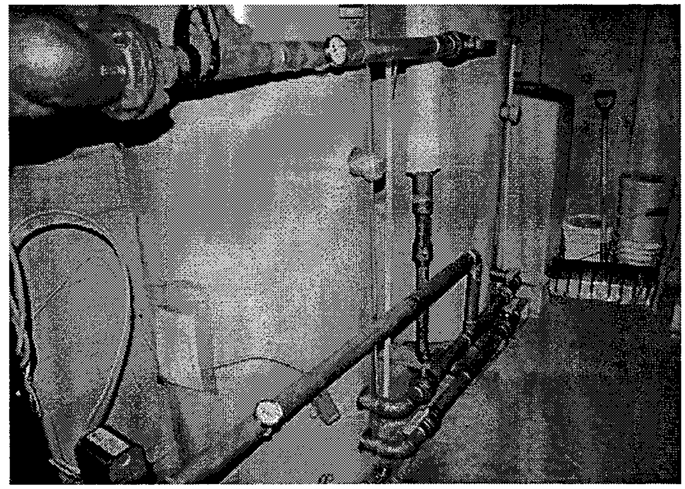

Photo 2--(8500) Glass lines storage tanks

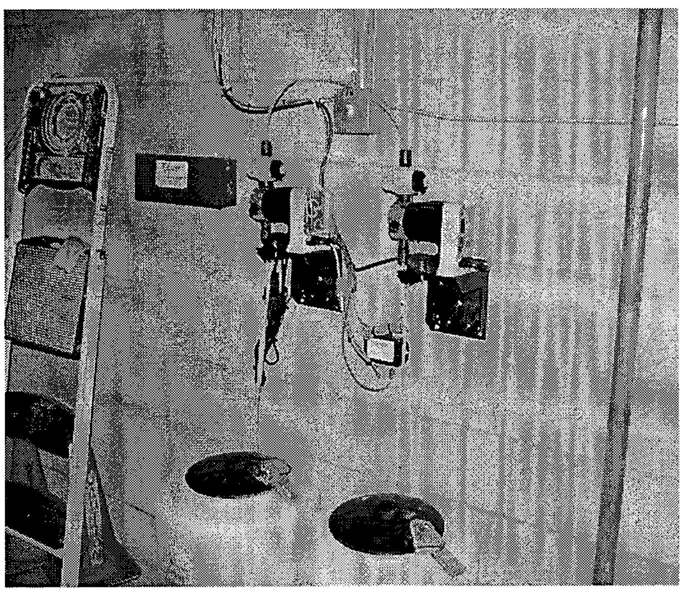

Photo 3 —(8500) Hytec chemical storage and feed system

Photos of Existing Systems

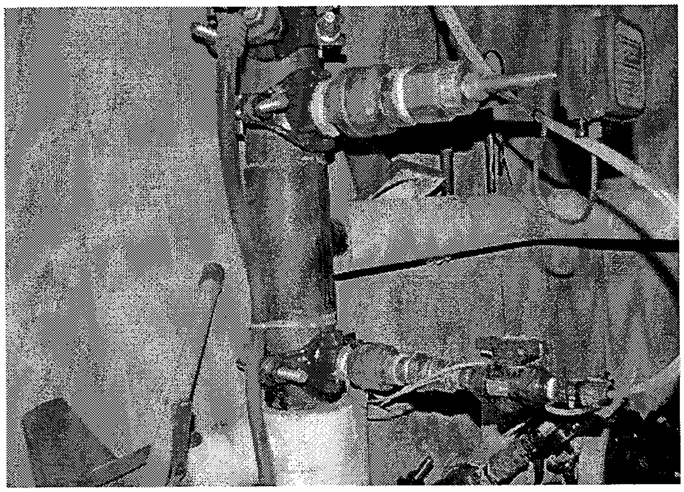

Photo 4--(8520/8560) Taps for Hytec chemical feed system

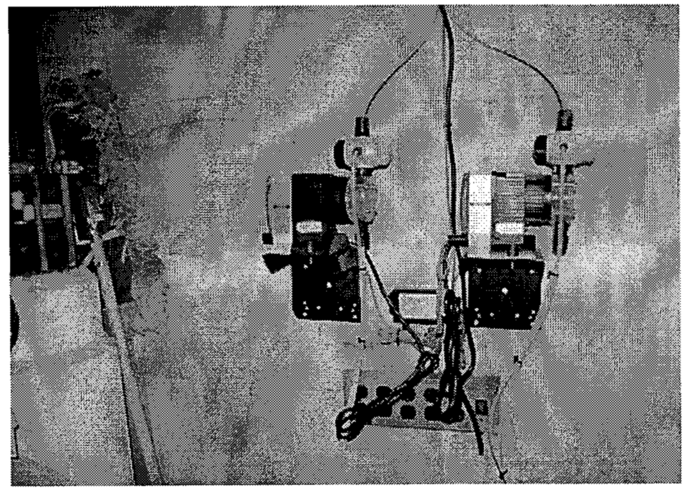

Photo 5--(8520/8560) Metering pumps for chemical feed system

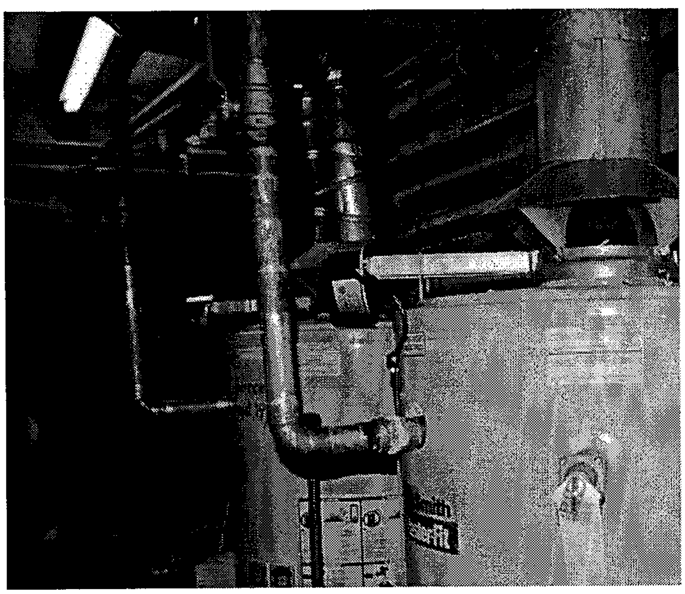

Photo 6--(8520/8560) Direct, gas fired water heater (typical of 3).

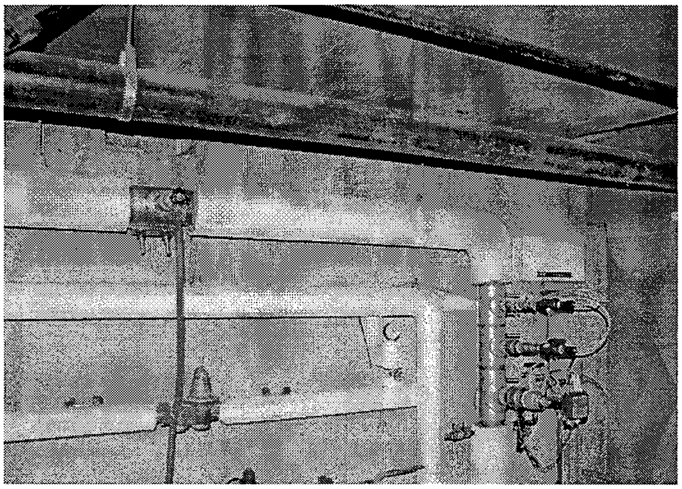

Photo 7--(8580) Chemical feed system on main supply piping

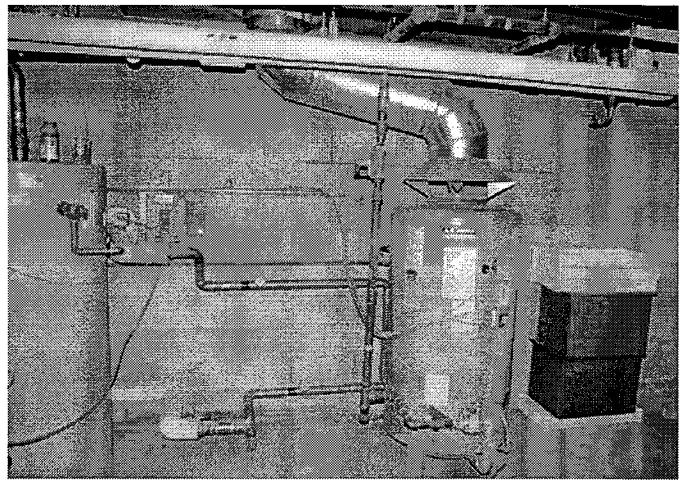

Photo 8--(8580) Direct gas fired water heater and storage tank (typical of 2)