

# Executive Summary

The City of Grande Prairie has experienced tremendous growth since 1995. In order to accommodate new developments, an investigation on the existing wastewater system is warranted. In 2003, Aquatera Utilities Inc. commissioned Infrastructure Systems Ltd. (ISL) to update the 1995 Wastewater Collection System. The major activities undertaken in this analysis included:

- Updating and re-calibrating the existing wastewater system model
- Determining the need for any upgrading required in the existing system for both present and future growth scenarios.
- Recommending ultimate servicing for future growth areas through the construction of new trunk sewers. This included costs and timing for the construction.

## **Updating and Re-Calibrating the Existing Wastewater System Model**

The existing wastewater system model and flow monitoring and rainfall data from the 1999 to 2001 period were obtained from Aquatera. Based on a review of the data, it was found that flow monitoring data under large rainfall events, was unavailable except for a storm of less than 2-year return period. In addition, high quality flow monitoring data was only available in newer residential areas. There was a lack of good data in commercial/industrial areas, as well as older portions of the city. Based on this, recommendations were made for future flow monitoring to increase accuracy of the updated model.

Based on the available and useful flow monitoring data, re-calibration of the model was undertaken. The update of the existing model consisted of two steps. Firstly, newly developed areas were added to the existing model. Secondly, a variety of improvements on the existing Wastewater Collection System since 1995 were incorporated into the model. After the existing model was fully updated, the model was run using available rainfall data and then calibrated with the high quality flow monitoring data that was available. Due to a lack of good flow monitoring data in the downstream

portions of the sewer system, flow monitoring data from the wastewater treatment plant were used.

### **Existing System Analysis**

After calibrating the model, an analysis of the existing Wastewater Collection System was undertaken. This analysis was conducted under numerous rainfall distributions of various return periods.

The existing system analysis identified several problem areas based on the present and future growth:

- The 200mm sewer east of 100 Street north of 116 Avenue was found to be a bottleneck with a high risk of basement flooding.
- The 92 Street Trunk was found to be near capacity. Future growth serviced into this trunk would drastically increase the risk along this sewer.
- Numerous downtown areas are problematic because the trunk sewer draining through the downtown area is under surcharge condition. Due to the fact that no good quality flow monitoring data was available in the downtown/older areas of the city, it was recommended that flow monitoring stations shall be installed in the downtown area to collect flow monitoring data. The additional data will be used to assess the upgrading requirements for the wastewater system in this area.
- The pump station in the southeast near Country Club Estates cannot handle the volume of flows under wet weather conditions and hence caused sewage to backup in local sewers along 60 Avenue. This deficiency will be corrected once new trunk sewers in the area are completed.

### **Ultimate Servicing for New Development Areas**

To service new development areas, particularly on the east and west sides of the city, the following new sewer trunks will be required.

- A new trunk sewer along 88 Street to service the east side of the City.
- A new trunk sewer along 116 Street to service the west side of the City.

These trunk sewers can be implemented in stages

In addition to servicing the ultimate development specified within the city, several areas outside the city for future annexation were also considered in the assessment. These future annexation areas included the 5 ¼ sections east of 88 Street between 100 Avenue and 60 Avenue and approximately 2¼ sections west of 116 Street between 92 Avenue and 84 Avenue. New trunks to service these future development areas were also determined.

### ***Interim Servicing for New Area***

This assignment also investigated interim servicing for new developments prior to the construction of the trunk sewer.

- Approximately 112 lots east of Ivy Lake can be connected into the Ivy Lake Sub-Trunk, if storage and off-peak pumping are utilized. These 112 lots will ultimately be connected to the 88 Street Trunk once constructed. A total of 132 lots can be developed with off-peak pumping to the 92 Street Trunk. This allows for any combination totalling 132 lots between direct connection to the 92 Street Trunk and the Ivy Lake Sub-Trunk with a maximum of 112 lots connected to the Ivy Lake Sub-Trunk.
- New developments near 116 Street and 100 Avenue can be connected into 375mm line along 100 Avenue up to 2007. At that time, construction of the 116 Street Trunk sewer must commence.
- Based on the recommended Alignment 1b, the section of trunk sewer between 116 Street and 100 Avenue, and 108 Street and 68 Avenue will need to be constructed by 2007 at a cost of \$9.1 million. The trunk sewer will be connected to an existing 375mm line along 68 Avenue. The remaining section of the 116 Street Trunk, from 108 Street and 68 Avenue to existing MH200002 at 102 Street and 66 Avenue, will then be constructed by 2013 at a cost of \$2.6 million.
- Upstream of 116 Street and 100 Avenue, developments south of the Bear Creek will be serviced by the northern portion of the 116 Street Trunk. This sewer, which will be constructed in 2012, will be at a cost of \$1.3 million.

## **Conclusions**

### ***1. Model Limitations***

- Rainfall data obtained did not include any large storms with return periods greater than two years. This will affect the accuracy of the model in less frequent storm events. The model may, in fact, over-estimate flows in less frequent storm

events. For example, when running the 10 year storm event, flows may be representative of a 25-year storm event.

- Flow monitoring data was of good quality in newer residential areas. No quality data was obtained from older areas of the city or industrial/commercial areas. Therefore, model accuracy is questionable in the older areas of the city where quality flow monitoring data were not available. However, in newer residential areas, the model is considered quite effective.

## **2. Existing System Assessment**

- The 92 Street Trunk is at its maximum capacity for its current service area. It appears that the trunk sewer can still service a small future development. However, this would create a surcharge condition in the trunk sewer and hence increase potential risk.
- The Ivy Lake Sub-Trunk is a potential source of basement flooding and measures to reduce flows in this area should be considered.
- The 108 Street Trunk is deemed adequate to service infill development of all areas presently serviced by it. If new developments in the northwest are allowed to connect into this trunk sewer, a slight surcharge condition will occur in the trunk sewer. However, the surcharge condition is not consistent to be significant enough to create a problem.
- As identified in the 1995 Master Plan, the area along the 200mm sewer east of 100 Street and north of 116 Avenue, has a risk for basement flooding. Despite the inflow/infiltration reduction procedures undertaken by the City in the past, these areas are still subject to the risk of basement flooding. Measures to mitigate flows in this sewer are necessary.
- The downtown area appears to have substantial surcharging throughout. Additionally, the 675mm trunk south of downtown also appears to be experiencing severe surcharging. However, due to a low confidence level in the model in this area, improvements were not proposed. Further study of this area will be warranted.
- The local sewer upstream from the Country Club Estates pump station experiences a surcharging condition during wet weather. This situation will steadily worsen until such time that the 60 Avenue Trunk is completed.
- Spare capacity is available in 375mm sub-trunks along 100 Avenue on the west end, and along 68 Avenue in the southwest. The spare capacity will allow for

interim servicing for new development areas until a new trunk is built along 116 Street.

## **Recommendations**

### **1. Wastewater Collection System Design Criteria**

- The Harmon Residential Peaking Factor currently utilized by Aquatera / the City of Grande Prairie, should be changed to the City of Edmonton's Residential Peaking Factor formula. This recommendation is based on an analysis of the flow monitoring data which indicated that the City of Edmonton peaking factor formula is a better representation of actual wastewater flows in the City of Grande Prairie. The peaking factor will not be less than 1.5 and greater than 4.0.
- The peaking factor of 2 applied for commercial/industrial areas should be changed to coincide with the formula given by the provincial standards. This will ensure more accurate representation of flows from these areas.
- Inflow/Infiltration (I/I) allowance should be changed from 0.10L/s/ha to 0.28L/s/ha. Based on the analysis of flow monitoring data for a small event of less than two- year return period, the I/I exceeded the present standard or 0.10L/s/ha. The 0.28L/s/ha standard has been adopted by many municipalities in Alberta.
- Pipe design flow should be increased over peak flow by a factor of 1/0.864. This will conform to provincial standards and provide an additional factor of safety in the system design.

### **2. Wastewater Modelling Software**

- Based on an analysis of commercially available software for modelling sanitary sewer systems, it is recommended that Aquatera adopt XP-SWMM Version 8.52 for modelling software because it is cost-effective and user-friendly.

### **3. Future Flow Monitoring/Rainfall Data Collection**

- Rainfall monitoring should be carried out in the future at multiple locations in the city to ensure that rainfall data corresponding to flow monitoring data will be available, particularly for a storm event of lower frequency. The additional rainfall monitoring data will improve model accuracy.
- Flow monitoring should be conducted in the future, as specified in Figure 6.1., to ensure flow monitoring data will be available for older residential areas and

commercial areas. These areas will be more accurately represented in future model revisions when the new flow monitoring data is available.

#### ***4. Existing System Upgrading for Infill Development***

- The Crystal Lake Estates area should ultimately be diverted to the 88 Street Trunk. This will reduce the risk in the existing 92 Street Trunk as well as in the areas around Ivy Lake.
- Land within 400m of the existing 92 Street Trunk should be allowed to connect to this trunk. This can be made feasible by the diversion of the Crystal Lake Estates area.
- To reduce risk from surcharging in the 200mm sewer in the lane east of 100 Street and north of 116 Avenue, a diversion should be constructed from the 200mm sewer west across 100 Street to the 300mm sewer located there. This diversion should be constructed near 124 Avenue.
- Accounting for infill development rates in the southeast and the existing capacity of the pump station located near Country Club Estates, the remaining section of the 60 Avenue Trunk sewer should be constructed no later than 2008. This will ensure that the risk to the local sewer near 60 Avenue would be minimized.

#### ***5. Ultimate Servicing of New Development Areas***

- The new 88 Street Trunk sewer should be constructed as shown in Figure 8.1. This trunk sewer should be sized to accommodate the Crystal Lake Estates area so that the risk in the Ivy Lake area can be reduced. Additionally, the trunk sewer should be sized to accommodate the five quarter sections just east of 88 Street for potential future development. This total construction cost is approximately \$6.2 million.
- Service for the area northwest and west of Grande Prairie can be accomplished by constructing a new trunk sewer along 116 Street, similar to the alternative alignment proposed in the 1995 Master Plan. This sewer will be designed to service all new developments west of 108 Street. Areas local to the northwest trunk, including new areas north of the Bear Creek, will be allowed to flow down the existing 108 Street Trunk. It is determined that there will be little risk along the 108 Street Trunk sewer.
- Based on the Net Present Value Analysis, Alignment 1b is the recommended alignment for the new 116 Street Trunk sewer as shown in Figure 8.2. Although

Alignment 3 has lower construction cost than Alignment 1b, Alignment 1b can provide interim servicing, and the costs are distributed far enough into the future to overcome the comparative cost advantage to Alignment 3. Therefore Alignment 1b is recommended for implementation. In addition, Alignment 1b can also accommodate the development of Southwest Grande Prairie. The estimated construction cost of Alignment 1b is \$15.7 million for ultimate servicing.

#### **6. Wastewater Trunk Sewer**

- Aquatera should work with developers to fund construction of the south end of the 88 Street Trunk, from 66 Avenue to 100 Avenue as it is extended northward as development occurs. Developments that are upstream of this future trunk and wish to proceed in advance of its construction are to develop where interim measures are available. In these cases, the developers will pay costs for interim servicing and the portion of the trunk sewer adjacent to or within the development. Aquatera will pay oversizing costs to developers who construct trunk sewers and recover them through future levies of charges.
- The 116 Street Trunk sewer, south of 100 Avenue to 68 Avenue, shall be implemented in 2007 or earlier.
- The 116 Street Trunk sewer north of 100 Avenue shall be constructed in 2012.
- The 116 Street Trunk sewer south of 68 Avenue shall be constructed in 2013.

