CHAPTER 5

Wastewater Collection Evaluation

5-1. INTRODUCTION

The City of Fife (City) will require improvements to its collection system to accommodate in-City growth, collection system expansions, and to repair damaged and deteriorating facilities. This chapter presents the evaluation of the City's existing sewer collection system. Individual sewer system components were analyzed to determine their ability to meet policies and design criteria under existing, existing plus the sewer transfer area, and future flow conditions. The policies and design criteria are presented in **Chapter 3**, and the sewer system analysis is presented in **Chapter 4**. A description of the existing sewer system facilities and current operation is presented in **Chapter 1**.

5-2. SEWER MODEL BACKGROUND

Hydraulic Model

Background

For this General Sewer Plan (GSP), Version 8i (SELECTseries 3) of the SewerCAD® program, developed by Bentley Systems, Inc., was used to model a portion of the sewer collection system. The collection system modeled included the gravity and force mains along 20th Street East, 70th Avenue, and 26th Street East. The following sewage pump stations were modeled: Pump Stations 5, 6, 8, 11, and 13. The hydraulic model was created, and pipe location, length, diameter, and material were added using information provided by PACE Engineers, Inc., as part of the completion of the City of Fife Sewer System Plan Amendment (**Appendix D**), and from design plans created by Tetra Tech, Inc. (*LID 98-2 Contract 2, December 2001*) (**Appendix M**). Manhole invert and rim elevation data was used, if available, and the remaining elevation data was extracted from Pierce County topographic and United States Geological Survey data. Minimum slope and cover depths were also used in the model when no other information was available. These areas are annotated in the model. The output from this model was used to evaluate the capacity of the existing collection system and to identify improvements that will be required to handle existing and existing with the Edgewood connection of 600 equivalent residential units (ERU). The model can be updated and maintained for use as a tool to aid in future planning and design.

Model Limitations

Due to the number of data gaps and assumptions used in the model, the accuracy of the geographic information system (GIS) input information from the City should be confirmed prior to undertaking any replacement or rehabilitation projects. The results of the modeling should be considered approximate and additional investigations, such as field surveys, flow monitoring, and confirmation of pump station firm capacity, should be performed in the vicinity of any proposed improvements prior to design and construction. If it is found that the input information differs significantly from

actual conditions, then the model should be updated accordingly and rerun to confirm the original results.

The modeling was performed using a steady state analysis, which shows all flows reaching all downstream points simultaneously. This is conservative and not truly representative of conditions that occur, since it takes some time for wastewater to travel downstream through the sewer system. In addition, assumptions were made for the force main for Pump Station 8 due to the lack of record drawings for this station.

Flow Data

A hydraulic model was constructed to simulate peak flows for 2014 under existing conditions and with the Edgewood connection of 600 ERUs anticipated in the near future. These hydraulic scenarios were based on the assumptions for infiltration/inflow and peaking factors described in **Chapter 4**. An I/I factor of 650 gallons per day per acre (gpd/acre) was used for the Edgewood connection area. The wastewater generated from this area was assumed to be connected at the boundary between the City and the City of Edgewood at 26th Street East.

In order to model the flows along 20th Street East, 70th Avenue, and 26th Street East, January 2012 water consumption data received as part of the City's water system plan effort was used. The water consumption data was added to the manhole closest to each parcels' centroid. It was assumed that the January 2012 water data was equivalent to the average day flow of the sewer system.

Facilities

The hydraulic model of the existing system contains Pump Stations 5, 6, 8, and 13. Pump Stations 11 and 12 were modeled as point loads into the collection system. Available information for each pump station, such as pump capacity, total dynamic head (TDH), horsepower, wetwell diameter, wetwell depth, and force main diameter, is included in the model, if available. For simplicity, the pump stations are modeled as constant-discharge pumps so that they produce a constant discharge regardless of TDH conditions.

Hydraulic Analyses Results

Hydraulic analyses were performed assuming a peaking factor of average day flow to peak hour flow of 3.5 and assuming an I/I rate of 1,100 gpd/acre for existing conditions and 650 gpd/acre for the Edgewood Sewer Transfer Area. In the evaluation, the criteria for listing a sewer pipe as deficient is that the peak hour flow exceeds 80 percent of the pipe flow capacity in terms of depth to diameter (d/D). The results of the hydraulic analyses are given in **Appendix N** and **Figures 5-1** and **5-2**.

Gravity Collection System Pipe and Pump Station Capacity Deficiencies

Figure 5-1 presents the gravity mains, force mains, and pump stations modeled on the south side of the Interstate (I-5) corridor, and highlights current system deficiencies in red. Pump Stations 6 and 5 were also modeled but are not shown on the figure for brevity. A table is included on the figures that provide the length of deficient main for a d/D of 0.8 (80 percent capacity) and for a d/D of 1.0 (100 percent capacity). As presented on **Figure 5-1**, 400 linear feet of pipe in 20th Street is greater than 80 percent capacity. This pipe is located in sewage drainage Basin 8 and represents existing conditions (2014).

Figure 5-2 provides the same information but includes the sewer transfer area from the City of Edgewood. This analysis resulted in an additional 1,400 linear feet of pipe over 80 percent capacity in 20th Street, and 1,400 linear feet of pipe over 80 percent capacity in 70th Avenue for a total of 2,800 linear feet of pipe impacted by the Edgewood Interlocal Agreement (ILA). This represents current conditions (2014) for inside the City plus the full 600 ERUs for Edgewood.

The system was also modeled for future conditions (2035) both with and without the Edgewood ILA. However, due to limited projected growth within the City the length of pipe over capacity in 2035 does not change from that impacted in 2014. The results are presented in **Table 5-1**.

Table 5-1
Pipes Over 80 Percent Capacity with and without Edgewood ILA

		2014 PHF	2014 PHF + Sewer Transfer Area PHF	2014 Difference
Location	Diameter of Gravity Main (in.)	Length of Gravity Main (LF)	Length of Gravity Main (LF)	Length of Gravity Main (LF)
20th St. E	12	100	100	0
	18	300	1,700	1,400
70th Ave. E	10	0	1,400	1,400
Total		**400**	**3,200**	**2,800**

		2035 PHF	2035 PHF + Sewer Transfer Area PHF	2035 Difference
Location	Diameter of Gravity Main (in.)	Length of Gravity Main (LF)	Length of Gravity Main (LF)	Length of Gravity Main (LF)
20th St. E	12	100	100	0
	18	300	1,700	1,400
70th Ave. E	10	0	1,400	1,400
Total		**400**	**3,200**	**2,800**

Current pump station capacities, existing average and peak hour flows, and average and peak hour flows with the Edgewood sewer transfer area are provided in **Table 5-2**.

Table 5-2
Projected Sewage Pump Station Peak Hour Flow Rates

Pump Station	Number of Pumps			2014			2014 with Edgewood Sewer Transfer Area		
		Nominal Capacity (gpm)	Existing Firm Capacity (gpm)	ADF (gpm)	PHF (gpm)	% of Firm Capacity	ADF (gpm)	PHF (gpm)	% of Firm Capacity
PS-13	3	370	740	56	197	27%	176	616	83%
PS-8	2	1,200	1,200	413	1,447	121%	519	1,817	151%
PS-6	3	1,630	3,260	1,010	3,537	108%	1,010	3,537	108%
PS-5	3	1,250	2,500	1,098	3,844	154%	1,098	3,844	154%

Based on the flow projections in **Table 5-2**, Pump Stations 8, 6 and 5 exceed their capacity during peak hour flow events. Capacity upgrades to these pump stations will be necessary to handle future flows. The additional flow from the Edgewood Sewer Transfer Area Will exacerbate the capacity deficiencies.

Capacity testing is highly recommended for the four pump stations evaluated above to verify the firm capacities and to confirm the modeling results. Degradation of equipment and changed conditions will have a significant effect on the nameplate flow rates. **Chapter 6** includes a capital improvement program (CIP) item (CIP No. 12) to verify the capacities of the pump stations through field testing. There are several alternatives to resolve these capacity issues and these alternatives should be vetted during predesign.

Appendix M contains the Tetra Tech design plans, which include the phasing the pump station improvements. This information is presented in **Table 5-3**.

Table 5-3
Phase II Pump Station Capacities

Pump Station	Number of Pumps	Nominal Capacity (gpm)	Phase II Firm Capacity (gpm)[1]
PS-1	3	700	1,400
PS-5	5	1,075	4,300
PS-6	5	1,750	7,000
PS-12	3	1,025	2,050
PS-13	3	370	740

[1] Phase II firm capacity based on the Pump Schedule included in Appendix M

The pump stations presented in **Table 5-3** can be easily upgraded with the replacement of the existing pump motors and impellers and the installation of one to two new pumps dependent on the pump station. The piping and valving were designed and constructed in such a way that the installation of the new pumps in Pump Stations 5 and 6 are "plug and play." A third pump is already installed in Pump Stations 1, 12, and 13. Pump Stations 1 and 12 would require replacement of the pump motors and impellers while Pump Station 13 is already at its Phase II firm capacity. Any upgrades to the pump stations should evaluate the predesign efforts by Tetra Tech as part of the LID 98-2 Sanitary Sewer Improvements (**Appendix M**). The predesign did not include Pump Station 8 but this pump station is included in CIP No. 19 in **Chapter 6** due to capacity deficiencies.