
COLLECTION SYSTEM MODELING EVALUATION CRITERIA

9.1 INTRODUCTION

Upon completion of the limited wet weather flow calibration, a capacity analysis of the modeled existing collection system was performed. It should be emphasized that the results presented in the following chapters are based on using the peak flow equation and the modeled peak rainfall event to occur simultaneously over the total (City wide) modeled drainage area. The capacity analysis entailed identifying areas in the collection system where flow restrictions occur or where pipe capacity is insufficient to convey peak wet weather flow (PWWF) events.

Chapter 10 through 23 presents the results of the hydraulic evaluation of the collection system under existing and future conditions, and identifies recommended improvements. The criteria to assess the hydraulic adequacy of the collection system and to develop hydraulic improvements are also presented below.

9.2 DESIGN CRITERIA AND CONSTRAINTS

The hydraulic evaluation criteria apply to existing sewers that may be needed to provide additional hydraulic capacity in the existing collection system. The hydraulic performance assessment was performed using existing and future wet weather flow conditions as described elsewhere in this report.

This section presents the criteria used to evaluate the existing and future collection system. Using these criteria, solutions were formulated for each alternative by solving conveyance and overflow problems in the collection system. These guides consist of planning objectives, design criteria, and physical constraints. Using these criteria, existing pipes that are inadequate to convey the modeled peak flows, as well as new pipes to potential new service areas were identified.

9.2.1 Existing and Future System Evaluation Criteria

The capacity and performance of the existing and future system scenarios were evaluated based on the following criteria:

1. **Pipe Capacity and Surcharging:** The primary hydraulic assessment of the modeled gravity sewers was based on surcharging which is the best indicator of pipes at risk of causing a SSOs. Surcharging is generally associated by two primary causes. The first is related to inadequate hydraulic capacity. The second is related to backwater which is usually caused by a downstream hydraulic restriction. The hydraulic capacity analysis indicated if surcharging was caused by inadequate hydraulic capacity or by a backwater issue.

2. **Sanitary Sewer Overflows (SSOs):** Sanitary sewer overflows occurring during the peak wet weather flow conditions should be eliminated. SSOs are noted as “flooding” or “flooded structures” in the model.
3. **Pipe Capacity:** Pipe capacity was calculated in the XP-SWMM model for the modeled pipes. Under the peak flow conditions, the ratio between the depth of flow and the diameter of the trunk sewer (d/D) was limited to not exceed 95 percent. Capacity limiting problems were identified at pipes that exceeded this threshold value. Siphons and adjacent pipes are noted as exceptions to this rule.
4. **Pipe Velocity:** Generally, velocities should be maintained between 2 and 10 feet per second (ft/s). Velocities less than 2 ft/s could cause solids deposition which can contribute to decreased pipeline capacity and promote sulfide generation. Velocities greater than 10 ft/s have been contributed are associated with excessive scouring and hydrogen sulfide release caused by hydraulic turbulence. Generally, the velocities analyzed were evaluated under peak flow conditions.

9.2.2 Recommended Improvements Criteria

A series of design objectives and criteria were established for development and evaluation for proposed improvements. The main purpose of these objectives and criteria was to provide guidelines for the evaluation of the City’s sanitary sewer collection and conveyance facilities. The general objectives used in developing alternatives were:

1. Reduce frequency of surcharging and eliminate sanitary sewer overflows.
2. Maintain or improve flow condition while mitigating overflows.
3. Prevent increase in overflows or hydraulic grade line (HGL) elevations elsewhere without adequate mitigation or other suitable compensation.

The options of replacement and upsizing of sewers were considered in all situations and implemented where deemed appropriate.

9.3 MODEL SCENARIOS

A total of five model scenarios were developed to analyze the City’s collection system. The scenarios include both existing and future conditions. The future conditions include planning Tiers I, II and III. The model scenarios are summarized in Table 9.1 below.

The existing system was evaluated to identify inadequacies and problem areas. The system was evaluated to determine what pipes or pumps were potentially limiting collection system efficiency. Evaluation of the efficiency of the collection system was based on the capacity of the pipes under peak wet weather flow conditions. Capacity was illustrated using a d/D ratio.

Table 9.1 Existing System Model Scenarios Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska	
Scenario	Description
Existing	Existing developed and sewerred areas
Tier I (25 years)	Tier I (Existing and Planning Tier I)
Tier II (50 years)	Tier II (Existing and Planning Tiers 1 and II).
Tier III (100 years)	Tier III (Existing and Planning Tiers 1, II and III).
I/I Flow Reduction ⁽¹⁾	Simulations of five I/I flow reduction targets for Tiers I, II and III
Notes	
1. Not specifically evaluated for all modeled trunk sewers	

The model was run during the weekday diurnal wet weather design flow to assess capacity, SSO and velocity related problems. The model was examined during the design flow peak hour. At this time, the peak flow produced the maximum hydraulic stress to the system. The results of all model runs are presented in Appendix D.