

Sanitary Sewer Study

prepared for

Bowlin Road Residential

NE Bowlin Rd and NE Jamestown Rd
Lee's Summit, MO

Initial Submittal: July 24, 2020

Revised: August 21, 2020

Schlagel & Associates Project 20-107

prepared by

SCHLAGEL & ASSOCIATES, PA
Lenexa, Kansas



08.21.2020

EXECUTIVE SUMMARY

Schlagel & Associates, PA is submitting the Bowlin Road Residential development project for preliminary development plan approval on behalf of our client, Stag Commercial, LLC, and this Sanitary Engineering Report in support of the applications. This report has been prepared to address sanitary sewer peak flow generation and existing downstream capacity analysis in accordance with City of Lee's Summit design criteria.

The 33.71-acre site is a proposed residential development with associated infrastructure on an existing row crop land description. The site lies in the Little Blue Valley Sewer District (LBVSD) and is proposed to connect to the LBVSD sanitary interceptor north of the site. Existing sanitary engineering reports provided by the City of Lee's Summit detail the limiting downstream sanitary sewer capacity as 11.13 MGD with an excess capacity of 3.49 MGD. The proposed development is estimated to generate an additional peak flow of 0.067 MGD, with a resultant downstream excess capacity of 3.42 MGD.

TABLE OF CONTENTS

Page No.

EXECUTIVE SUMMARY I

1.0 GENERAL INFORMATION..... 1-1

 1.1 Objective..... 1-1

 1.2 Methodology..... 1-1

2.0 SEWER CONNECTION LOCATION..... 2-1

 2.1 Little blue valley service district..... 2-1

3.0 WATERSHED DEVELOPMENT 3-1

 3.1 Watershed Area..... 3-2

 3.2 Proposed Development onsite and offsite flows..... 3-2

 3.3 existing flows..... 3-3

4.0 HYDRAULIC ANALYSIS 4-1

 4.1 Immediate sanitary mains downstream of proposed connection 4-1

 4.2 Combined Flows **Error! Bookmark not defined.**

5.0 SUMMARY AND RECOMMENDATIONS 5-1

APPENDIX A – SITE INFORMATION

- Location Map/Current Aerial Photo
- Proposed Sanitary Main Extension Exhibit
- Proposed Site/Grading Plan

APPENDIX B – SUPPORTING CALCULATIONS

- Engineering Solutions/ACH Sanitary Studies
- City of Lee’s Summit Sanitary Map Exhibit (Existing GIS)

* * * * *

1.0 GENERAL INFORMATION

Bowlin Road Residential is a proposed 33.71-acre multi-family and single-family development, located in Section 3-47-32 in the City of Lee's Summit, Missouri. A location is provided in Appendix A.

The proposed development has topographic challenges which require the proposed sanitary main extension to connect to the LBVSD Interceptor located to the north and offsite of the project. This interceptor is located on the east side of the ridge adjacent to Campground Road.

1.1 OBJECTIVE

The intent of this report is to determine the necessary improvements required to provide sanitary sewer service to the Bowlin Road Residential project. The recommendations of this report will be reviewed by the City of Lee's Summit for conformance with their design criteria, and will be used as the design basis for the sanitary sewer construction documents.

1.2 METHODOLOGY

The City of Lee's Summit Design Criteria Section 6500 will be utilized for the basis of design. Sanitary sewer watersheds will be determined from GIS topographic information and adjacent land use designations. Existing sanitary sewer capacities detailed in the following city provided reports serve as the basis for the downstream capacity analysis:

- "Sanitary Study – Monticello, Lots 1-160" sanitary analysis prepared by Engineering Solutions, Matthew J Schlicht, P.E., dated May 4, 2015, with attachments from the previously approved ACH, LLC Sanitary Study detailing ultimate watershed peak flow characteristics.

* * * * *

2.0 SEWER CONNECTION LOCATION

The Little Blue Valley Sewer District Interceptor was reviewed for potential connection location and is discussed in the following section.

2.1 LITTLE BLUE VALLEY SERVICE DISTRICT

As-built plans for the sanitary sewer main extension which connects the existing Monticello residential development south of the project site to the LBVSD Interceptor were obtained and reviewed. The proposed project main extension is anticipated to connect to Manhole 06-047, as-builts obtained will be utilized for watershed development and hydraulic analysis.

* * * * *

3.0 WATERSHED DEVELOPMENT

Watershed peak flow rates are determined per Section 6501.C, and are comprised of the sum of Peak Base Flow (PBF), Peak Infiltration, and Peak Inflow, and are defined as follows:

Peak Base Flow is calculated at 1500 gallons per day per acre for residential proposed watersheds with this analysis. This is considered to be the normal sanitary flow generated by the sewer system exclusive of infiltration and inflow. Non-residential Peak Base Flow calculations were utilized for the apartment complex portion of the proposed development.

Peak Infiltration is defined as groundwater entering the system through defective pipes, pipe joints, and manholes. Peak infiltration is considered the maximum infiltration that occurs during the highest groundwater level period of the year. For purposes of this report, a factor of 500 gallons per day per acre for residential lands will be used.

Peak Inflow is defined as rainfall-related water entering the collection system from sources such as private building sewers, down spouts, foundation drains, sump pumps, and cross connections, and is determined by the following equation:

$$Q = KiA$$

Where;

Q = peak inflow, cubic feet per second (cfs)

K = inflow factor, 0.006 for residential lands

i = rainfall intensity that corresponds to a tributary area's time of concentration, inch per hour (iph), 50-year design storm

A = tributary area, acres (ac)

The rainfall intensity is calculated per the table provided in Lee's Summit Design Criteria Section 6105.C.1.d, utilizing a Time of Concentration calculated by the following equation:

$$T_c = 18.56 (A)^{0.2524}$$

Where;

T_c = time of concentration, minutes (min)

A = tributary area, acres

3.1 WATERSHED AREA

The onsite tributary area from the Bowlin Road Residential development is 33.71-acres. The proposed offsite main extension to manhole 06-047 will be sized in accordance with City of Lee's Summit Design Criteria, utilizing an 8 inch PVC pipe with a minimum slope of 1.0%. Capacity of this pipe would be 1.21 cfs vs. a peak flow generated of 1.04 cfs.

3.2 PROPOSED DEVELOPMENT ONSITE AND OFFSITE FLOWS

The onsite flows generated by the proposed development were calculated as follows:

Non-Residential Peak Base Flow Calculations			
Unit Calculations			
Building Type	No. of Buildings	No. of Units/Bldg	Sub-Total Unit Count
I	17	11	187
II	6	16	96
III	1	88	88
Total Unit Count			371
Per City of Lee's Summit Design and Construction Manual Sanitary Sewers - Section 6500			
6501.C.2.b: Assumed 300 gpd/unit			
PBF = 300 gpd/unit*(total units)			
PBF_{NR} =	111300	gpd	0.1722 cfs

Residential Peak Base Flow Calculations			
Per City of Lee's Summit Design and Construction Manual Sanitary Sewers - Section 6500			
6501.C.2.a: Peak base flow rate is 1500 gpd/ac			
PBF = 1500 gpd/ac*(residential acreage)			
Residential Area (ac.) =	4.2		
PBF_R =	6300	gpd	0.00975 cfs

Peak Infiltration Calculations			
Per City of Lee's Summit Design and Construction Manual Sanitary Sewers - Section 6500			
6501.C.2.b: Peak infiltration rate is 500 gpd/ac			
PBF = 500 gpd/ac*(total acreage)			
Total Development Area (ac.) =	33.71		
PIG =	16855	gpd	0.02608 cfs

Peak Inflow Calculations	
Per City of Lee's Summit Design and Construction Manual Sanitary Sewers - Section 6500	
6501.C.2.c: $Q = KiA$	
where	
Q = peak inflow, cubic feet per second (cfs) (1.0 cfs = 646,317 gpd)	
K = inflow factor	
i = rainfall intensity that corresponds to a tributary area's time of concentration, inch per hour (iph)	
A = tributary area, acres (ac)	
K =	0.006 (per 6501.C.2.ii)
A (ac.) =	33.71
Tc (min) =	18.56 (A) ^{0.2524} = 45.10
i (iph) =	4.11 (per 6501.C.2.ii - 6501.C.d) - interpolated
PIF =	537276 gpd 0.831 cfs

Peak Flow = Peak Base Flow (PBF) + Peak Infiltration (PIG) + Peak Inflow (PIF)		
Peak Flow =	671731 gpd	1.039 cfs 0.672 MGD

3.3 EXISTING FLOWS

As detailed in the Engineering Solutions and ACH sanitary studies, the entire tributary area of the LBVSD Interceptor had been previously analyzed. This analysis was completed for ultimate development conditions, with single family development anticipated for the undeveloped portions of the tributary area, excluding area associated with park land. Downstream analysis indicates that the downstream segment "A" as detailed in the Engineering Solutions and ACH sanitary studies (see Appendix B) is the limiting capacity downstream segment. The Engineering Solutions and ACH sanitary studies report the following:

From ACH Sanitary Study (Lee's Summit Criteria)		
Min. Downstream Segment Flow Capacity - Segment A	11.13	MGD
Segment Flow at per ACH Study - Segment A	6.73	MGD
Excess Capacity - Segment A	4.40	MGD

From Engineering Solutions Sanitary Study (Lee's Summit Criteria)		
Peak Flow Generated by Monticello Development	0.911	MGD
Peak Flow with Monticello Development - Segment A	7.64	MGD
Excess Capacity - Segment A	3.49	MGD

As discussed, the previous studies provided tributary area analysis for ultimate development conditions. This analysis accounted for Peak Inflow and Peak Infiltration calculations, as well as single family peak flows for the entirety of the 33.71-acre Bowlin Road Residential project area. Proposed Peak flow calculations for the Bowlin Road Residential development were adjusted to account for the peak flows previously accounted for in the ultimate development conditions.

Resultant Peak Flow at Downstream Segment A (Lee's Summit Criteria)		
Peak Flow Generated by Proposed Bowlin Development	0.672	MGD
Existing Single-Family Land Use Flow *	0.051	MGD
Existing Inflow*	0.537	MGD
Existing Infiltration*	0.017	MGD
Resultant Peak Flow Increase from Bowlin Development	0.067	MGD
Post-Bowlin Development Peak Flow - Segment A		
	7.71	MGD
Fully Developed Excess Capacity - Segment A		
	3.42	MGD
* Existing sanitary studies indicate that project area is accounted for in ACH/Engineering Solutions' peak flow calculations as single-family residential land use with associated inflow and infiltration.		

* * * * *

4.0 HYDRAULIC ANALYSIS

With flows determined, the capacity and characteristics of the downstream main can be verified. This is completed utilizing the Manning's Equation for gravity flow. All computations for maximum pipe capacity were calculated assuming the pipe is flowing 94% full.

$$V = (1.486/n)(R)^{2/3}(S)^{1/2}$$

$$Q = (1.486/n)(A)(R)^{2/3}(S)^{1/2}$$

Where;

Q = pipe flow capacity (cfs)

V = velocity (fps)

A = inside area of pipe (ft²)

R = hydraulic radius (ft)

S = pipe slope (ft/ft)

n = Manning's pipe roughness coefficient

4.1 IMMEDIATE SANITARY MAINS DOWNSTREAM OF PROPOSED CONNECTION

Sanitary sewer mains upstream of the proposed connection to Manhole 06-047 will be designed in accordance with City of Lee's Summit Design Criteria and will be addressed with future plan submittals. The capacity of the existing main immediately downstream of the proposed main extension connection at Manhole 06-047 was determined to verify ultimate flow capacity. Downstream pipe characteristics were derived from Monticello main extension as-built documents provided by the City of Lee's Summit.

Downstream Pipe Capacity - Manning's Eqn - Closed Pipe - Flowing Full										
U.S. MH	D.S. MH	Pipe Dia. D (in)	Pipe Dia. D (ft)	Pipe Area A (ft ²)	Wet. Per. P (ft)	Hyd. Rad. R (ft)	Slope S (dec)	Roughness n	Velocity V (ft/s)	Discharge Q (ft ³ /s)
06-047	06-023	12	1.00	0.785	3.142	0.250	0.0072	0.012	4.170	3.275

Downstream Pipe Capacity - Manning's Eqn - Closed Pipe - Flowing 94% Full								
Pipe Dia. D (in)	Flow Depth h (in)	Flow Area A (ft ²)	Wet. Per. P (ft)	Hyd. Rad. R (ft)	Slope S (dec)	Roughness n	Discharge Q (ft ³ /s)	Velocity V (ft/s)
12	10.65	0.737	2.458	0.300	0.0072	0.012	3.468	4.707

* * * * *

5.0 SUMMARY AND RECOMMENDATIONS

Downstream capacity analysis indicates that additional peak flows generated by the proposed development will not have an adverse impact on the Little Blue Valley Sewer District Interceptor due to the adequate capacity of the existing downstream main and 12" Ductile Iron Pipe, therefor, Schlagel & Associates, P.A. recommends the sanitary main extension associated with the Bowlin Road Residential project connect to Manhole 06-047.

* * * * *