LOW PRESSURE SANITARY SEWER STUDY

WOODLAND OAKS

SW Corner Colbern & Blackwell

Site Acreage: 20.81 Acres

Lee's Summit, MO

PREPARED BY:

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING

50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER
PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht, PE

Revision

Date	Comment	By
4-6-22	Full LPS w/ Revised Alignment	AEP

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3. GENERAL INFORMATION

This study has been prepared to evaluate a low pressure sewer (LPS) alternative for complete sanitary service of the proposed single family residential subdivision, Woodland Oaks. Due to topographic challenges in addition to potential capacity issues with adjacent gravity sanitary sewers a LPS system is required to serve the development. The proposed development shall consist of 42 single family residential lots. The site is located at the southwest corner of Colbern Road and Blackwell Road. The property is bound by Colbern Road to the north, Blackwell Road to the east, Woodland Shores a single family residential subdivision to the south and a large acre single family tract to the west. Woodland Oaks is tributary to Lake Jacomo which is located to the northwest just across Colbern Road. The site is a tract of land located in the SE ¼ of Section 27, Township 48 North, and Range 31 West. See Exhibit A for an aerial view of the site along with the surrounding area.

4. METHODOLOGY

LPS capacity and hydraulic criteria shall at a minimum conform to Missouri Department of Natural Resources (MDNR) Minimum Design Requirements as outlined in 10 CSR 20-8.

- Velocity. Design shall be based on the most probable number of pumping units expected to operate simultaneously or on some other acceptable method of computing the peak pumpage rate. Environment One Corporation (E/One) Design Assistant 9 Software will be used to determine most probable number of pumping units expected to operate simultaneously along with associated peak velocities. E/One is a leader in the LPS field and has numerous time tested systems operating successfully throughout Missouri.
- A cleansing velocity of at least two feet per second (2 fps), at least once and preferably several times per day, shall be achieved. Projected velocities may be found in the E/One design report located in the Appendix.
- Minimum size. The minimum diameter sewer main pipe shall not be less than one and a half inches (1.5"). The minimum 1.5” forcemain size will handle a maximum of three homes. The use of 1.5” main in lieu of 2” will depend on lot layout and configuration.
- Service Line Connection. The minimum diameter service line pipe shall be one and one quarter inches (1.25"). Per discussion with the City a lateral assembly consisting of both a ball and check valve shall be located 5 feet from the forcemain. The City will own and maintain everything downstream of the isolation ball valve. The HOA or Private Resident shall own, operate and maintain the lateral assembly and all appurtenances upstream including the simplex grinder pump station and control panel. The LPS system shall terminate at the edge of the sanitary easement with a capped 1.25” service line.
- Simplex grinder pump station shall not serve multiple equivalent dwelling units (EDU) if owned, operated, and maintained by individual homeowners; and not serve commercial facilities.
- Storage volume. A grinder pump vault shall have a storage volume of at least seventy (70) gallons.
- Design Flow. Single family lots are projected to produce average daily flows of 370 gpd each (100 gpd per capita x 3.7 capita/dwelling). Peak hour demand per lot is 1,617 gpd or 1.12 gpm (370 gpd x 4.37 Peak Factor) well below the proposed pump capacity of 11 gpm. A pump curve for the proposed grinder pumps may be found in the Appendix.
- The roughness coefficient, C for the proposed pipe shall be 120.

In addition to developing a scouring velocity of 2 fps in the system a maximum fluid retention time in the system should be less than 24 hours to minimize creation of septic conditions. These two parameters along with total dynamic head will be the basis of design for the proposed forcemains.

5. LPS SYSTEM DESIGN

The development consists of 42 lots all of which will be served by the LPS system. The LPS forcemain will be comprised of a main trunk starting at NE Woodland Oak Circle and running along NE Woodland Oak Drive. The forcemain will exit the development and head south along the west right-of-way of Blackwell Road. The forcemain will then turn west at the south right-of-way of NE Woodland Shores Drive and terminate at the southeast corner of NE Woodland Shores Drive and NE Woodland Shores Circle. The forcemain will be connected to an existing 8” PVC gravity main located approximately 35 feet south of manhole 26-305 for further gravity conveyance downstream to the Woodland Shores Pump Station. Two branches will be included in the design to serve residences along NE Lashbrook Circle and NE Cherrybark Court. A proposed general layout for the LPS system may be found in Exhibit B.

Service lines and all upstream appurtenances shall be 1.25”. Service line shall be HDPE SDR-11 and terminate at the edge of easement with a pipe cap. All lateral assemblies shall be placed 5’ from the forcemain to minimize non-isolatable service line while allowing emergency shutoff of the residence. The public forcemain will commence just downstream of the ball valve. The lateral assembly which consists of the ball and check valve shall be privately owned along with all line and appurtenances upstream including the simplex grinder station and the control panel.

5.1 GRINDER PUMPS

The low-pressure sewer system design was based on the DH071 grinder pump manufactured by E/One Sewer Systems. These units feature a 1 horsepower motor and have a typical discharge of 11 gpm at 40 psi. They have a storage capacity of 70 gallons and are rated by the manufacturer for up to 700 gallons per day. The manufacturer’s pump curve may be found in Exhibit C. Each pump will have an internal check valve and will be installed with a gate valve on the service lateral near the property line. Additionally, each pump will be installed with a control panel that includes a high level alarm. The grinder pump stations and additional service line shall be installed with construction of the homes.

5.2 FORCEMAIN

The forcemain design was completed using software developed by E-One along with guidance provided by the pump manufacturer. The design involves breaking the system down into zones, with each zone defined by a given number of pump connections. Zone 1 is typically located furthest away from the receiving structure with subsequent zones being added at all branches and changes in pipe size. The branch structure facilitates pipe sizing for each zone based upon a statistically probable number of simultaneous pump operations. Pipe sizes were determined by requiring a minimum velocity of 2 feet per second for average daily flows, as well as maintaining a maximum fluid retention time in the system of less than 24 hours. The required pipe material is HDPE SDR-11. All branches shall terminate with an end of line flushing assembly. The City has requested an odor/corrosion control system be furnished along with an air release valve/vault at the forcemain high point. The City also requests two manholes both upstream and downstream of the tie-in point be coated with epoxy. The proposed layout only has one manhole upstream of the tie-in point therefore only one manhole will be epoxy coated upstream.

The forcemain was modeled with eight zones. Zone 1 was placed farthest from the outlet or gravity tie-in point while Zone 8 consisted of the last run of forcemain which tied into the existing gravity system offsite. Forcemain consisted of both 2 and 3 inch segments. The maximum pressure in the system occurred in Zone 1 at 152.52 feet of head, which is less than the 185 feet recommended by the pump manufacturer. Zone 1 consists of the first three lots on Forcemain 1. Maximum scouring velocities of 2 fps were obtained in all eight zones with the lowest scouring velocity occurring in Zones 1, 3 and 6 at 2.38 fps. The maximum retention time was calculated at 2.03 hours in Zone 1. The proposed peak flow from the LPS system as determined by E-One Design Software was determined to be 66 gpm or 0.147 cfs as provided by 6 simultaneous pumps operating. The final design calculations are summarized and provided in Exhibit D.

6. RECEIVING GRAVITY SEWER CAPACITY ANALYSIS

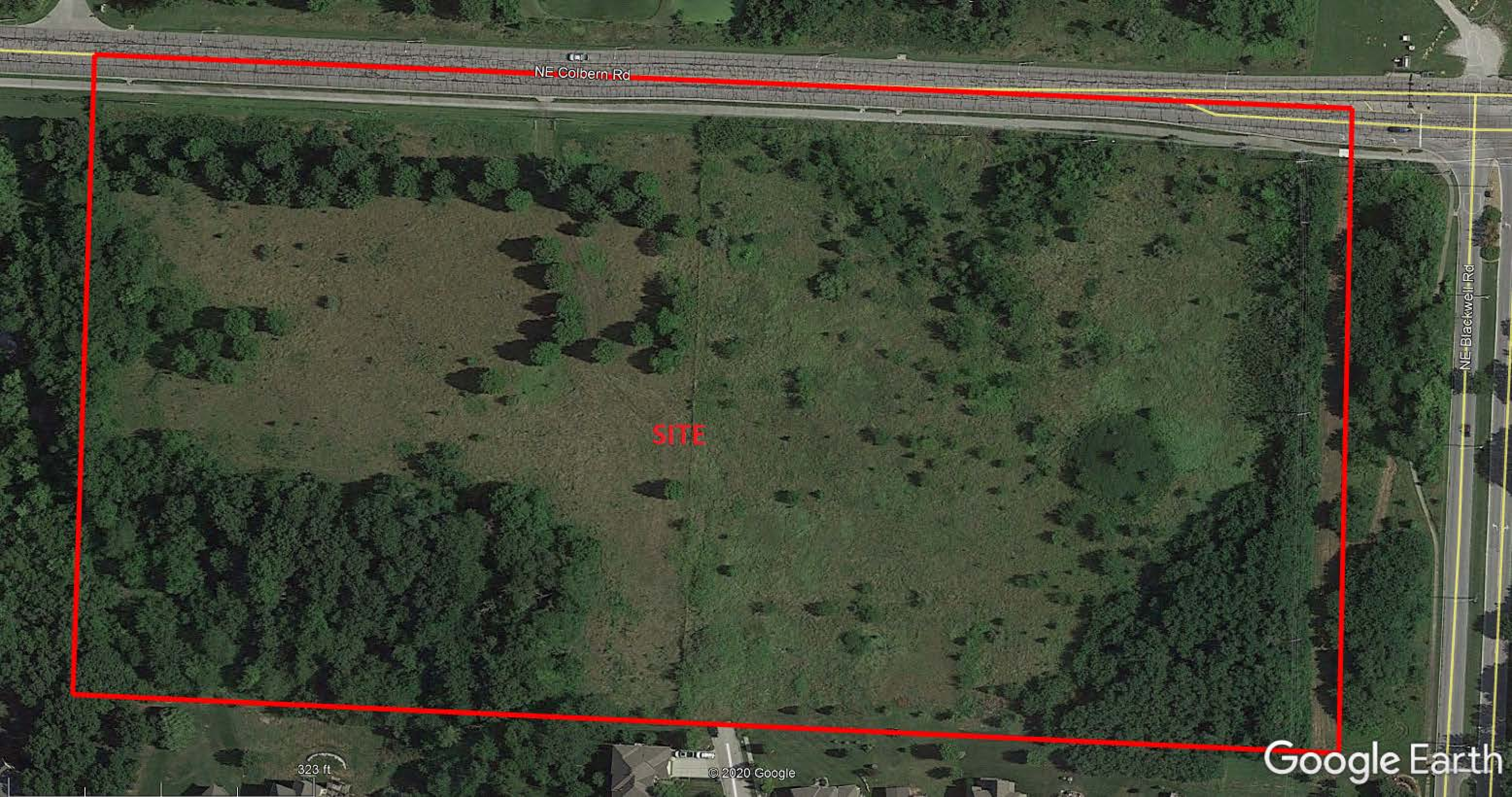
The Woodland Shores gravity sanitary sewer capacity analysis was terminated at the Woodland Shores pump station wetwell labeled 62-002PS, see Sanitary Sewer Map, located in Exhibit E, for both the existing sanitary sewer system layout along with proposed development location and tie-in point. There are currently 57.98 +/- acres tributary to wetwell 62-002PS, see Exhibit F Sanitary Sewer Tributary Area Map from original CES study. The existing serviceable area outlined by CES appears to be reasonable and has been utilized for this analysis. The proposed development will utilize the east branch of the sewer system to convey flow. All tributary area has been accounted for to wetwell 62-002PS as stipulated by the City's design criteria. The proposed development consists of 42 single family residences to be served by a LPS system. The proposed peak flow for the proposed development as determined by E-One Software (66 gpm or 0.147 cfs) was added to the Peak Flow column at upstream manhole 26-305 and carried thru to the wetwell 26-002PS. The proposed development may be served by the existing downstream sewer system with no surcharging anticipated as outlined in Exhibit G Sanitary Sewer Capacity Analysis.

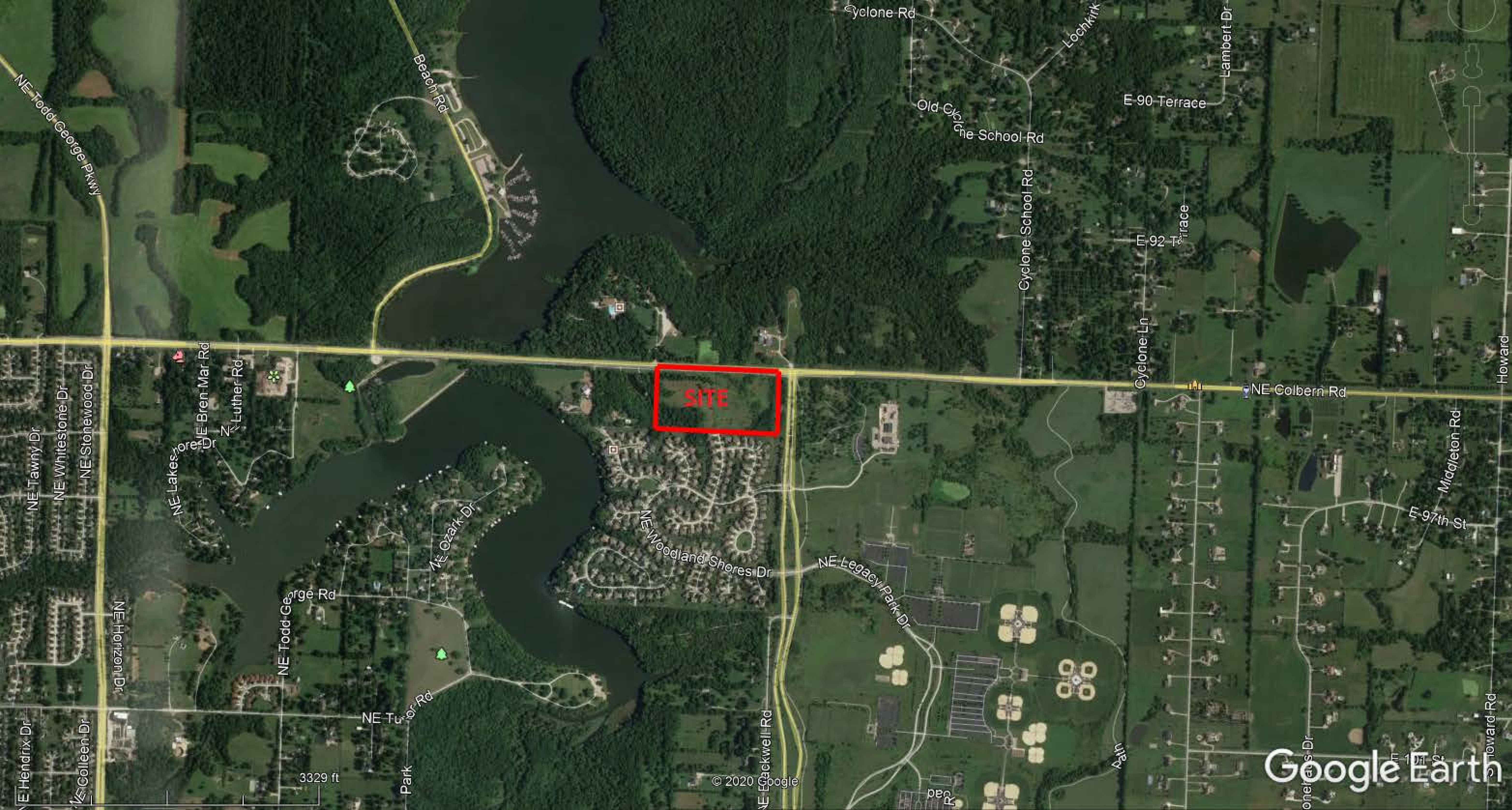
7. CONCLUSIONS & RECOMMENDATIONS

An LPS system and existing gravity system will be able to provide sanitary sewer service for 42 residences in the proposed development without any adverse impacts to the community or downstream sanitary system. We recommend that an LPS system as described in this report be constructed to service the 42 residences as shown on the general layout.

Exhibit A

Aerial Images


NE Colbern Rd
NE Blackwell Rd
SITE
323 ft
© 2020 Google
Google Earth



Cyclone Rd
Lochkirk
Lambert Dr
Beach Rd
NE Todd George Pkwy
Old Cyclone School Rd
E 90 Terrace
Cyclone School Rd
Cyclone Ln
NE Colbern Rd
Howard
SITE
NE Bren Mar Rd
NE Tawny Dr
NE Whitestone Dr
NE Stonewood Dr
Middleton Rd
E 97th St
NE Ozark Dr
NE Woodland Shores Dr
NE Legacy Park Dr
NE Horizon Dr
Howard Rd
NE Hendrix Dr
NE Colleen Dr
Park
Path
3329 ft
© 2020 Google
Google Earth

Exhibit B

Sanitary Sewer General Layout

GRAPHIC SCALE

0 40' 80' 160'

SANITARY GENERAL LAYOUT

SCALE: 1" = 80'

GENERAL NOTE:

1 ~ ALL CONSTRUCTION SHALL CONFORM TO THE CITY OF LEE'S SUMMIT DESIGN AND CONSTRUCTION MANUAL AS ADOPTED BY ORDINANCE 5813.

2 ~ TRENCH CHECKS SHALL BE INSTALL AT ALL SANITARY WYES LOCATION.

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Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

Part of the Southeast $\frac{1}{4}$
Section 27, Township 48 North, Range 31 West
Lee's Summit, Jackson County, Missouri

Project: WOODLAND OAKS LSMO

Issue Date: February 25, 2021

Sanitary Sewer General Layout

Construction Plans for:
WOODLAND OAKS
Lots 1 thru 42
Lee's Summit, Jackson County, Missouri

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

REV. 5/5/2021
REV. 5/26/2021
REV. 6/22/2021
REV. 6/29/2021

C.401

Exhibit C

E/One Grinder Pump Flow Curve

E|ONE SPD PUMP PERFORMANCE CURVE

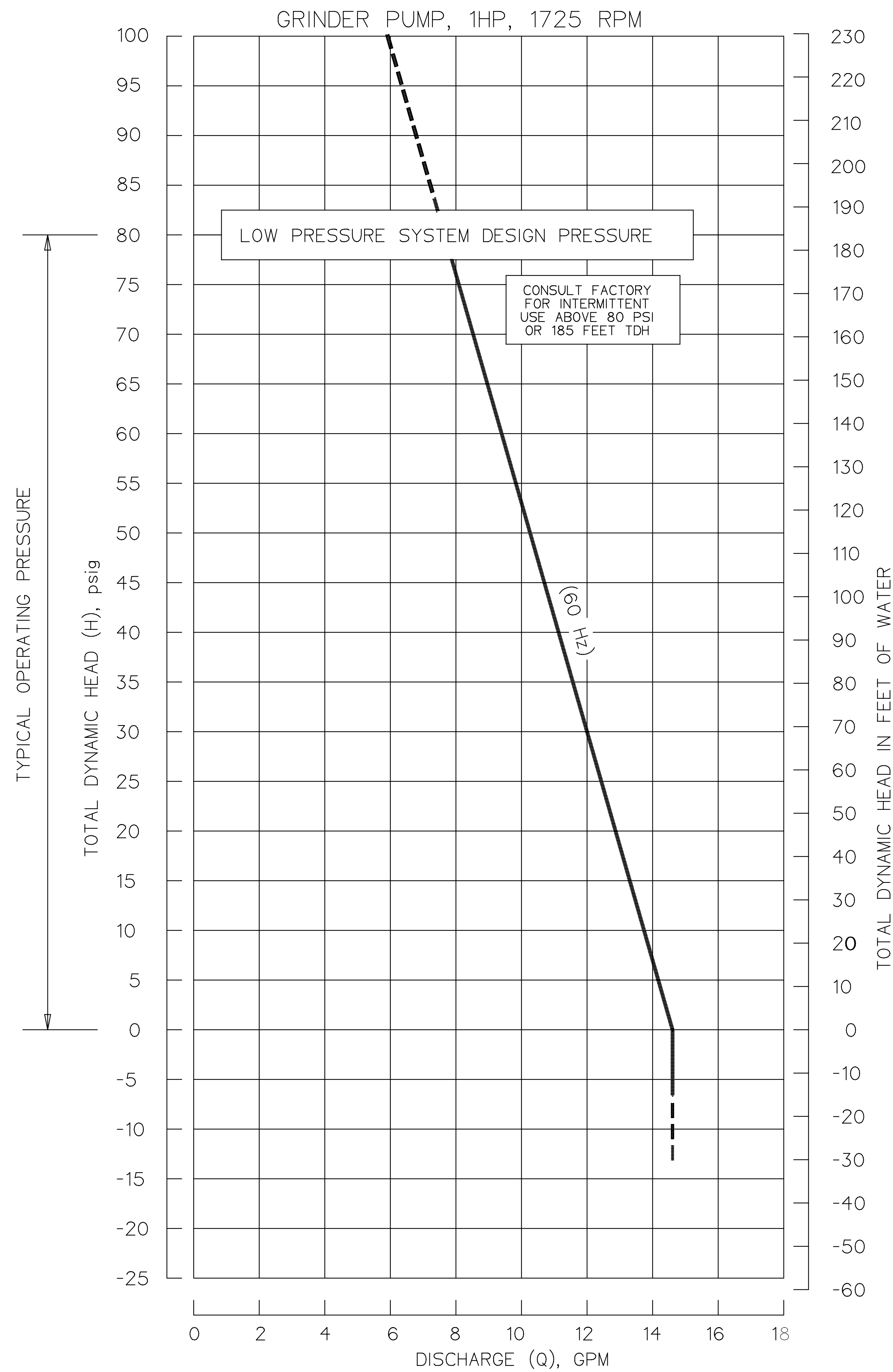

Exhibit D

E/One Design Summary

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:

April 6, 2022

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Fric Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness"C" of: 120							
1.00	2.00	3	3	370	11.00	2	22.00	2.00	2.38	145.14	1.80	2.61	97.52	980.00	925.00	55.00	152.52
2.00	5.00	14	17	370	11.00	4	44.00	2.00	4.76	864.19	6.49	56.08	94.91	980.00	925.00	55.00	149.91
3.00	4.00	3	3	370	11.00	2	22.00	2.00	2.38	80.96	1.80	1.46	56.29	980.00	941.00	39.00	95.29
4.00	5.00	4	7	370	11.00	3	33.00	2.00	3.57	420.05	3.81	16.00	54.83	980.00	940.00	40.00	94.83
5.00	8.00	7	31	370	11.00	6	66.00	3.00	3.29	409.30	2.08	8.52	38.83	980.00	941.00	39.00	77.83
6.00	7.00	3	3	370	11.00	2	22.00	2.00	2.38	80.70	1.80	1.45	48.66	980.00	941.00	39.00	87.66
7.00	8.00	5	8	370	11.00	3	33.00	2.00	3.57	443.75	3.81	16.90	47.21	980.00	941.00	39.00	86.21
8.00	8.00	3	42	370	11.00	6	66.00	3.00	3.29	1,456.22	2.08	30.31	30.31	980.00	947.00	33.00	63.31

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:

April 6, 2022

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE								Gals per Day per Dwelling		370
1.00	2.00	3	2.00	15.40	145.14	22.36	1,110	49.65	0.48	2.03
2.00	5.00	17	2.00	15.40	864.19	133.11	6,290	47.25	0.51	1.55
3.00	4.00	3	2.00	15.40	80.96	12.47	1,110	89.01	0.27	1.91
4.00	5.00	7	2.00	15.40	420.05	64.70	2,590	40.03	0.60	1.64
5.00	8.00	31	3.00	33.47	409.30	136.98	11,470	83.74	0.29	1.04
6.00	7.00	3	2.00	15.40	80.70	12.43	1,110	89.30	0.27	1.58
7.00	8.00	8	2.00	15.40	443.75	68.35	2,960	43.31	0.55	1.31
8.00	8.00	42	3.00	33.47	1,456.22	487.35	15,540	31.89	0.75	0.75

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

Exhibit E

Sanitary Sewer Map

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Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

Part of the Southeast $\frac{1}{4}$
Section 27, Township 48 North, Range 31 West
Lee's Summit, Jackson County, Missouri

Project: WOODLAND OAKS LSMO

Issue Date: February 25, 2020

Existing Sanitary Sewer Map

Preliminary Development Plans for:
Lots 1 thru 42
WOODLAND OAKS
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

City Comments 3-24-20
City Comments 3-31-20

C.300

Exhibit F

Sanitary Sewer Tributary Area Map

Construction Engineering Services,Inc.
16810 E. 40 Highway
Independence, Missouri 64055
Phone (816) 478-2323
Surveyors Engineers Planners
Missouri State Certificate of Authority
2001001857
Kansas Business Entity
PE - 834 LS - 136
kris@engineeringkc.com

Prepared For:
Carl Huff
656 SE BAYBERRY LN #101
LEES SUMMIT MO 64063

REV. NO.	DATE	BY
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Horizontal Scale 1" = 50'
Vertical Scale N/A
Date: 2-27-18
Designed: KNB

Exhibit A
Sanitary Sewer Area
Woodland Oaks

Lee Bodenheimer, MO LS 2114
Lee Bodenheimer, MO PE 018496
Lee Bodenheimer, KS LS 638
Lee Bodenheimer, KS PE 8731

Exhibit G

Sanitary Sewer Capacity Analysis

Woodland Oaks - Sanitary Sewer Capacity Analysis: City of Lee's Summit Criteria at Ultimate Buildout																
D.S. Str.	U.S. Str.	U.S. Str. Area (ac.)	Cum. Area (ac.)	Peak Flow (cfs)	FL IN	FL OUT	Length (ft)	Slope (ft/ft)	Dia (ft)	Material	n	Capacity (cfs)	Segment Condition	Rim El.	Surcharge Depth (ft)	U.S. Str.
26-002PS	26-166	0.01	57.98	1.625	902	902.9	7.37	0.1221	0.67	PVC	0.014	3.948	GRAVITY	916.07	0.00	26-166
26-166	26-167	**35.91**	57.97	1.624	903	903.96	14.36	0.0669	0.67	PVC	0.014	2.921	GRAVITY	916.68	0.00	26-167
26-167	26-178	1.24	22.06	0.794	904.04	915.01	251.41	0.0436	0.67	PVC	0.014	2.360	GRAVITY	923.31	0.00	26-178
26-178	26-179	1.53	20.82	0.762	915.21	918.62	302.68	0.0113	0.67	PVC	0.014	1.199	GRAVITY	929.47	0.00	26-179
26-179	26-180	0.45	19.29	0.722	918.72	920.71	385.5	0.0052	0.67	PVC	0.014	0.812	GRAVITY	942.37	0.00	26-180
26-180	26-181	**1.30**	18.84	0.710	920.81	921.80	144.69	0.0068	0.67	DIP	0.015	0.872	GRAVITY	944.90	0.00	26-181
26-181	26-182	**3.75**	17.54	0.675	921.95	922.96	133	0.0076	0.67	DIP	0.015	0.919	GRAVITY	947.08	0.00	26-182
26-182	26-183	0	13.79	0.573	923.04	923.64	92.09	0.0065	0.67	DIP	0.015	0.851	GRAVITY	945.64	0.00	26-183
26-183	26-184	0	13.79	0.573	923.79	926.03	330.76	0.0068	0.67	PVC	0.014	0.930	GRAVITY	933.94	0.00	26-184
26-184	26-185	**2.36**	13.79	0.573	926.18	927.29	87.96	0.0126	0.67	PVC	0.014	1.269	GRAVITY	935.49	0.00	26-185
26-185	26-186	1.52	11.43	0.507	927.39	929.99	149.14	0.0174	0.67	PVC	0.014	1.492	GRAVITY	936.19	0.00	26-186
26-186	26-187	0	9.91	0.463	930.17	938.26	221.61	0.0365	0.67	PVC	0.014	2.159	GRAVITY	951.11	0.00	26-187
26-187	26-188	**3.44**	9.91	0.463	938.55	938.87	42.27	0.0076	0.67	PVC	0.014	0.983	GRAVITY	950.62	0.00	26-188
26-188	26-200	0.25	6.47	0.362	938.92	939.68	80.32	0.0095	0.67	PVC	0.014	1.099	GRAVITY	949.80	0.00	26-200
26-200	26-299	**2.43**	6.22	0.355	939.78	948.75	130.58	0.0687	0.67	DIP	0.015	2.764	GRAVITY	963.48	0.00	26-299
26-299	26-300	0.28	3.79	0.284	950.15	951.9	103.01	0.0170	0.67	PVC	0.014	1.473	GRAVITY	965.37	0.00	26-300
26-300	26-301	0.57	3.51	0.275	952.9	957.6	94.87	0.0495	0.67	PVC	0.014	2.515	GRAVITY	969.22	0.00	26-301
26-301	26-302	0.44	2.94	0.257	959.6	962.94	134.21	0.0249	0.67	PVC	0.014	1.782	GRAVITY	975.33	0.00	26-302
26-302	26-303	1.15	2.5	0.242	963.14	964.36	126.94	0.0096	0.67	PVC	0.014	1.108	GRAVITY	976.54	0.00	26-303
26-303	26-304	0.52	1.35	0.202	964.86	966.35	179.26	0.0083	0.67	PVC	0.014	1.030	GRAVITY	978.90	0.00	26-304
26-304	26-305	0.83	0.83	0.182	966.55	967.72	117.28	0.0100	0.67	PVC	0.014	1.128	GRAVITY	979.94	0.00	26-305

*U.S. Str. Areas in bold account for additional upstream branch flow.

**Woodland Oaks Peak Flow = 66 GPM 0.147 cfs was added to Peak Flow at 26-305 and carried to Structure 26-002PS