STORM WATER DRAINAGE REPORT

LOTS 9A, 11A, 13A
A REPLAT OF LOTS 9-14, BLOCK 5
LOWE'S ADDITION
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

PREPARED FOR

705 HIGH STREET LLC

PREPARED BY

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821 NE Columbus St
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Date Prepared: April 6, 2021

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3.0 PROJECT OVERVIEW

The proposed project is a lot split for three proposed duplexes in Lee's Summit, Jackson County, Missouri. The area is residential with the current zoning as R-1 (Single Family Residential), with a proposed zoning of P-MIX (Planned Mixed Use). The total area of the property contains approximately 0.49 acres, with the proposed lot splits making three 0.16 acre tracts of land. The subject property does not lie in a floodplain.

There are two areas for drainage to occur: in the front and back yards. Drainage Area 1 is designated as the front yard area, and Drainage Area 2 is the back yard. Both areas flow easterly off the subject property as shown on the drainage map. The north side of the property drains to the existing grader ditches along the side of the road. There is not an enclosed system on this street. The south or rear of the property drains to the east and then to the south across a parking lot to the ditches in front of the commercial property. The commercial property drains to the ditch from the parking to using flumes.

The proposed development does not change drainage areas or switch flow patterns except for putting the duplexes in on the property. Most of the area is developed and was established as single family residential zoning previously and the existing drainage system was designed accordingly.

4.0 DRAINAGE ASSESSMENT OF THE PROJECT

The site has an existing house and garage with drives located on the half acre property. This report will address the existing conditions and capacities of the existing system in the field. We are proposing wit this study to request a variance from the requirements of section 5600 of the APWA Specifications and Design Standards. The specific waiver will be addressed later at the end of the report.

Attached is a drainage map and design results for open channel flow related to the ditches adjacent to the streets. These sections, shown on the site plan for the project, were actual survey sections to determine the approximate configuration of the ditches to determine their actual capacity. For the purpose of this study, we are using the section information to determine the maximum capacity of the existing ditches related to existing and proposed conditions. The report will not use the difference in the flows to justify the variance but determine the overall capacity of the ditches and whether the capacity matches the flows that are determined for the storm events.

To determine the flow in the ditches we used the spreadsheet and input the side slopes, ditch bottom width, slope and roughness coefficient for the 10 and 100 year storm. This study assumes the existing conditions use a “C” value of 0.51 for single family residential. The proposed “c” value used is 0.66 for multifamily development and this value was assigned to the entire drainage area which is a conservative approach.

The results are as follows:

Section	10 Year (cfs)		100 Year (cfs)		C-Value	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Swales 1 & 2	2.90	3.76	5.12	6.63	0.51	0.66
Swales 3 & 4	2.16	2.79	3.81	4.93	0.51	0.66

5.0 Conclusions and Summary

Generally, the total difference in the flows for the 10 year increased 0.63 to 0.86 cfs between existing and proposed conditions and for the 100 year the increase was from 1.12 cfs to 1.51 cfs. As shown above all of the ditches had the capacity for the 10 year storm at the current configuration and depth. The 100 year storm was not contained in Swale 2 by 0.3 feet, and the existing condition is not contained in the 100 year storm by 0.25 feet.

Based on APWA section 5601.6 waivers can be requested

The proposed project shows a minimal effect on the overall storm water leaving the site. It also shows that the capacity of the existing ditches handles the 10-year design storm and that the 100 year only goes above the top of the ditch by 0.3 feet at Swale 2. We respectfully submit for a waiver that no storm water management facilities or structures need to be constructed. APWA Section 5601.6 shown below.

5601.6 Waivers The Developer may submit a study by a registered professional engineer that quantifies the problems and demonstrates that a waiver (exemption) of the requirement to provide stormwater management is appropriate. The City/County Engineer may waive requirements to address unique conditions or constraints: A. Stormwater Management Facilities: Stormwater management facilities may be waived and/or release rates other than those permitted by Section 5608 when supported by a developer's Drainage Study performed in accordance with Section 5609 and approved by the City/County Engineer

Also, in APWA Section 5600 it states that drainage systems to convey the storm water are usually for drainage areas 2 acres or more. It is suggested that good grading principles be used related to storm water drainage areas less than 2 acres.

Section 5601.8 (A). a. and b.

Generally, a drainage system is engineered and constructed when the drainage area exceeds 2 acres.

It is our opinion that granting of the waiver meets the intent of APWA section 5600 and the City of Lee's Summit requirements.

6.0 APPENDIX

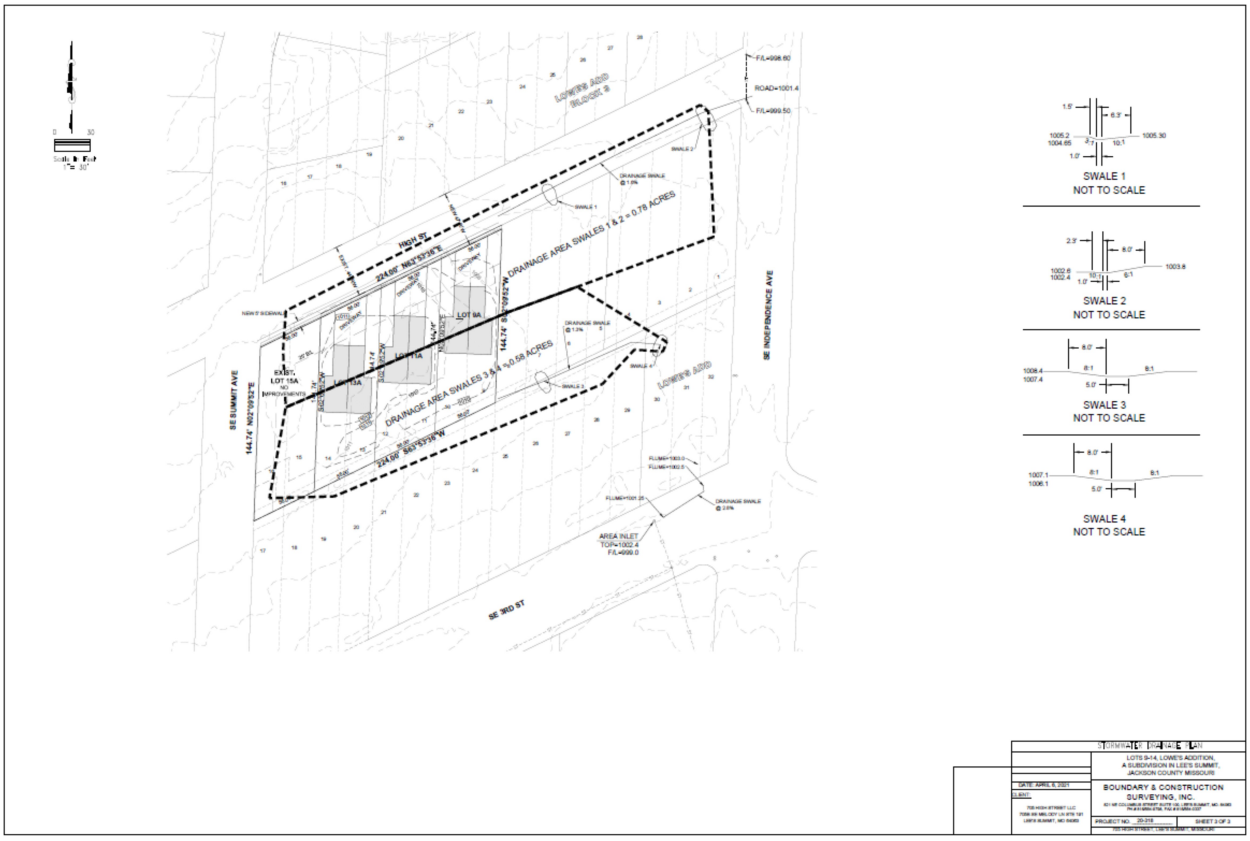
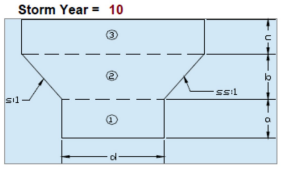


Figure A1. Drainage Area Map

Channel Flow, Velocity and Hydraulic & Energy Grade Lines

Storm Year = 10

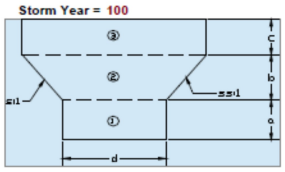


	Pipe Flow Q (cfs)	Area (acre)	Runoff Coefficient	Time of Conc. (min)	Rainfall Rate 10 (in/hr)	Flow Q10 (cfs)	Total Flow (cfs)	Dimensions of Channel								Slope (%)	Length (ft)	Area (ft^2)	Perimeter (ft)	Capacity Flow (cfs)	Capacity Check	Velocity (ft/sec)	Initial Water Elev. (ft)	Head Loss		EGL Elev. (ft)	HGL Elev. (ft)	Average Shear Stress	Critical Shear Stress	Shear Stress Ratio
								a (ft)	b (ft)	c (ft)	d (ft)	s (ft)	ss (ft)	n										Coefficient k	Head Loss (ft)					
	Swale 1	0.78	0.51	5	7.3	2.904	2.9	0	0.55	0	1	3	10	0.03	1.60%		2.51625	8.27	7.13	OK	2.84		0.4	0.050	0.05	-0.18	0.9829972	2.16	0.455091
		0.78	0.66	5	7.3	3.758	3.8	0	0.55	0	1	3	10	0.03	1.60%		2.51625	8.27	7.13	OK	2.84		0.4	0.050	0.05	-0.18	0.9829972	2.16	0.455091
	Swale 2	0.78	0.51	5	7.3	2.904	2.9	0	0.4	0	1	10	6	0.03	1.60%		1.68	7.45	3.90	OK	2.32		0.4	0.033	0.03	-0.12	1.7973534	2.16	0.832108
		0.78	0.66	5	7.3	3.758	3.8	0	0.4	0	1	10	6	0.03	1.60%		1.68	7.45	3.90	OK	2.32		0.4	0.033	0.03	-0.12	1.7973534	2.16	0.832108
	Swale 3	0.58	0.51	5	7.3	2.159	2.2	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
		0.58	0.66	5	7.3	2.794	2.8	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
	Swale 4	0.58	0.51	5	7.3	2.159	2.2	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
		0.58	0.66	5	7.3	2.794	2.8	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539

Figure A2. Channel Flow, 10 Year Stormwater

Channel Flow, Velocity and Hydraulic & Energy Grade Lines

Storm Year = 100



	Pipe Flow Q (cfs)	Area (acre)	Runoff Coefficient	Time of Conc (min)	Rainfall Rate 100 (in/hr)	Flow Q100 (cfs)	Total Flow (cfs)	Dimensions of Channel							Slope (%)	Length (ft)	Area (ft^2)	Perimeter (ft)	Capacity Flow (cfs)	Capacity Check	Velocity (ft/sec)	Initial Water Elev. (ft)	Head Loss		EGL Elev. (ft)	HGL Elev. (ft)	Average Shear Stress	Critical Shear Stress	Shear Stress Ratio
								a (ft)	b (ft)	c (ft)	d (ft)	s (ft)	ss (ft)	n										Coefficient k	Head Loss (ft)					
Swale 1	0.78	0.51	5	10.3	5.122	5.1	0	0.55	0	1	3	10	0.03	1.60%		2.51625	8.27	7.13	OK	2.84		0.4	0.050	0.05	-0.18	0.9829972	2.16	0.455091
	0.78	0.66	5	10.3	6.628	6.6	0	0.55	0	1	3	10	0.03	1.60%		2.51625	8.27	7.13	OK	2.84		0.4	0.050	0.05	-0.18	0.9829972	2.16	0.455091
Swale 2	0.78	0.51	5	10.3	5.122	5.1	0	0.4	0	1	10	6	0.03	1.60%		1.68	7.45	3.90	NG	2.32		0.4	0.033	0.03	-0.12	1.7973534	2.16	0.832108
	0.78	0.66	5	10.3	6.628	6.6	0	0.4	0	1	10	6	0.03	1.60%		1.68	7.45	3.90	NG	2.32		0.4	0.033	0.03	-0.12	1.7973534	2.16	0.832108
Swale 3	0.58	0.51	5	10.3	3.808	3.8	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
	0.58	0.66	5	10.3	4.929	4.9	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
Swale 4	0.58	0.51	5	10.3	3.808	3.8	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539
	0.58	0.66	5	10.3	4.929	4.9	0	1	0	5	8	8	0.03	1.30%		13	21.12	53.12	OK	4.09		0.4	0.104	0.10	-0.38	1.2860432	2.16	0.59539

Figure A2. Channel Flow, 100 Year Stormwater

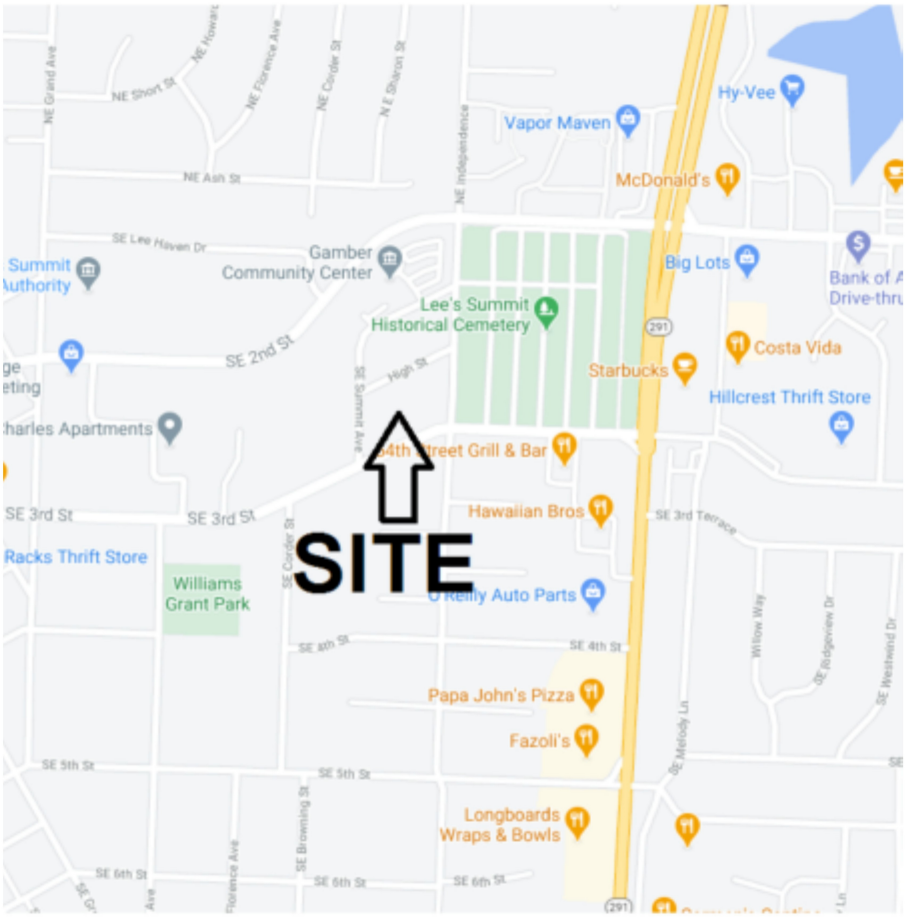


Figure A4. Site Location Map

Figure A5. USGS Map

Figure A6. Aerial View

Figure A7. Firmette Map