

MACRO STORM WATER DRAINAGE STUDY

WESTVALE ADDITION

SITE ACREAGE: 1.23 ACRES

Lee's Summit, MO

PREPARED BY:



Revision

Date	Comment	By

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3. GENERAL INFORMATION

The proposed Westvale Addition multi-family housing development (Development) is located northwest of the intersection of NW Fieldcrest Drive and NW Frances Street. The Development will consist of 9 units, drive aisle, parking and associated utility infrastructure. The property contains 1.27 acres. The site generally drains from north to south via sheet and shallow concentrated flow. The runoff is collected by an enclosed storm sewer system running along NW Frances Street. No storm sewer, BMPs, detention facilities nor water bodies currently exist on site. See Exhibit A for an aerial image of the proposed project site.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0416G, effective January 20, 2017.

See Exhibit B for a FEMA FIRMette which includes the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 22, May 29, 2020. The existing site contains two major soil types:

10128 Sharpsburg-Urban Land Complex, 2 to 5 Percent Slopes
Hydrologic Soils Group (HSG): Type D

10143 Snead-Urban Land Complex, 9 to 30 Percent Slopes
HSG: Type D

See Exhibit C for a detailed soils report of the proposed project site

4. METHODOLOGY

This Macro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed development and recommend improvements to eliminate potential negative impacts. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)
- Time of Concentration per APWA 5600

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre

- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed detention facility shall release the water quality event over a period of 40-72 hours. Design principles taken from the MARC BMP Manual will be utilized to assist in the design of the detention basin control structure for extended release events.

5. EXISTING CONDITIONS ANALYSIS

The existing site is grass covered and generally drains from north to south via sheet and shallow concentrated flow. Runoff is collected by the curb and gutter system running along SW Frances Street and captured by curb inlets for further conveyance downstream. Runoff is tributary to Cedar Creek. The existing site contains two drainage subareas labeled as A and B for the purposes of this report. Subarea A contains 0.79 acres and consists of the majority of the site. Subarea A drains to the south. Subarea B consists of 0.48 acres and drains to the north via sheet flow where it is intercepted by the parking lot of the adjacent development. See Exhibit D Existing Drainage Area Map for details of each Subarea. Table 5-1 below details the hydrologic properties for each Subarea along with peak discharge rates for the 2, 10 and 100-year storms.

Table 5-1 Existing Conditions Sub-area Data and Peak Discharge Rates

Subarea	Area (ac.)	CN	Tc (min.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	0.79	74	11.7	1.48	3.05	5.58
B	0.48	81	7.1	1.37	2.51	4.22

Exhibit E contains a full Hydraflow Hydrograph Report with pre and post development hydrographs for each subarea along with proposed detention basin data and routed hydrographs.

Per APWA Section 5608.4 and City of Lee's Summit criteria, the performance criteria for detention is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Allowable release rates are comprised of a combination of peak offsite flows and allowable onsite post development peak flows at each point of interest. Due to the nature of the drainage areas onsite and the surrounding infrastructure the onsite subarea limits were tied to the property boundaries. The area ratio method will be used to determine allowable release rates.

Allowable Release Example Calculation: Subarea A (2-Yr) = 0.79 x 0.5 = 0.40 cfs

Table 5-2 Existing Conditions APWA Allowable Peak Discharge Release Rates

Subarea	Onsite Area (ac.)	Offsite Area (ac.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	0.79	N/A	0.40	1.58	2.37
B	0.48	N/A	0.24	0.96	1.44

Subarea B is a peripheral (free release) area located on the north side of the site some minor grading will occur however no hard improvements will be constructed in this area. This subarea is not being negatively impacted

by the proposed improvements. Subarea A encompasses the proposed hard infrastructure improvements. Subarea A will be the focus of the remainder of the report.

6.0 PROPOSED CONDITIONS ANALYSIS

The proposed improvements will consist of a new 9-unit multi-family development with drive aisle, parking lot and associated utility infrastructure. The proposed site will consist of three drainage subareas referred to as A, A1 and B for the purposes of this report. Subarea A contains 0.15 acres of un-improved land generally located along the west and south property lines. Subarea A will free release to the south via sheet and shallow concentrated flow. Sub-area A1 contains 0.91 acres and will contain all of the proposed hard infrastructure improvements. The runoff from Subarea A1 will drain to a new earthen detention basin where the peak flows will be attenuated to allowable. Runoff from subareas A & A1 will be combined at the south property line or POI A. Subarea B consists of 0.22 acres of land located in the north. No hard improvements will be constructed in subarea B, a small portion of parking lot and drive aisle will continue to drain to the north. Exhibit F contains the Proposed Drainage Area Map. Table 6-1 below details the hydrologic properties for each sub-area along with peak discharge rates for the 2, 10 and 100-year storms.

Table 6-1 Proposed Conditions Sub-area Data and Peak Discharge Rates

Sub-area	Area (ac.)	Composite CN	Tc (min.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	0.09	74	6.50	0.21	0.42	0.76
A1	0.94	88	6.40	3.84	6.35	10.00
B	0.23	81	7.10	0.66	1.20	2.02

Subarea A is a peripheral area that will be free released. Subarea A1 contains the hard infrastructure improvements and will be detained. Attenuated runoff from subarea A1 will be combined with subarea A to determine overall peak flow to POI A the south property line. Subarea B is a peripheral free release area that does not contain any new hard improvements. Subarea B has been geographically reduced, has no improvements and yields lower peak flow rates than existing.

6.1 DETENTION

A new single stage earthen detention basin is being proposed in Sub-basin A1 to attenuate proposed peak discharge rates. Following are a list of design parameters for the detention system.

Designation: Detention Basin A1

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2% Min., Turf Lined

Basin Bottom Elevation: 956.00 @ Influent Pipe

Basin Top Berm Elevation: 962.00

Basin Volume: 20,127 cf @ 962.00

Control Structure: 5'x4' Precast Concrete Box

Baffle Wall Orifices: (7) 1" Diameter on 8" Centers, FL=951.10 (Bottom Orifice)

(1) 3" Diameter, FL=957.25

Baffle Wall Crest Elevation: 960.00

Control Structure Top Elevation: 961.00

Control Structure Overflow Weir Openings: N/A

Control Structure Influent Pipe: 18" HDPE, FL (In) = 952.00, FL (Out) = 951.30, L=66.45', S=1.05%

Control Structure Effluent Pipe: 18" HDPE, FL (In) = 950.90, FL (Out) = 943.35, L=130.00', S=5.80%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=960.50, Crest Length=31'

Consecutive 100-YR Q=10.00 cfs, Emergency Spillway HGL=960.75', Freeboard=1.25'
 40 Hour Extended Release Calculations (See Exhibit I) – 40 Hour Release will be met

The Detention Basin Plan for the Development may be found in Exhibit G. The detention basin emergency spillway calculations may be found in Exhibit H. See Table 6-2 for a summary of detention basin data.

Table 6-2 Proposed Detention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
2-Year	3.84	717	0.28	752	957.16	3,982
10-Year	6.35	717	0.63	742	958.42	6,670
100-Year	10.00	717	0.92	744	959.95	11,101

As shown in the table above all proposed peak flowrates have been attenuated. See Table 6-3 below for a summary of proposed peak discharge rates for combined Subareas A and A1. Hydrographs tributary to each area have been combined to determine subsequent peak discharge rates.

Table 6-3 Proposed Conditions Post Detention Peak Discharge Rates

Sub-Areas	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Combined A & A1	0.43	0.91	1.52

As stated previously Subarea B was not improved, will not create any negative downstream impacts and therefore does not require attenuation. Table 6-4 below provides a comparison of runoff data between Existing, Proposed and Allowable for combined Subareas A and A1.

Table 6-4 Peak Discharge Comparison

		Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Combined A + A1	Proposed	0.43	0.91	1.52
	Existing	1.48	3.05	5.58
	Difference	-1.05	-2.14	-4.06
	Allowable	0.40	1.58	2.37
	Difference	0.03	-0.67	-0.85

As is shown in Table 6-4 above peak discharge rates for combined Subareas A and A1 will be reduced well below existing discharge rates. In addition runoff from the water quality storm event will be detained and released over a minimum 40 hour time period. The proposed peak discharge rate for the 2-year storm is within 30 thousandths of the allowable and is within error tolerances.

7. CONCLUSION & RECOMMENDATIONS

This macro storm water drainage study shows that the Development will not generate any negative downstream hydraulic impacts. A new earthen detention basin located in the southwest corner of the property will provide attenuation.

In conclusion, proposed peak discharge rates are all well below existing discharge rates. The water quality storm will be detained and released over a 40 hour time period. The proposed peak discharge rates for POI A meet or exceed all allowable release rates. A waiver will be requested for POI B for the 2, 10 and 100 year storms. Subarea B is a peripheral area that has been geographically reduced and does not contain any new hard infrastructure improvements. No negative impacts are anticipated downstream from subarea B due to the reduction of existing peak flow rates. The study is in conformance with all applicable City of Lee's Summit

standards and criteria therefore Engineering Solutions recommends approval of this macro storm water drainage study.

Waivers:

1) POI B – 2, 10 and 100 Year Allowable Release Rates, The subarea is peripheral to the proposed improvements. The subarea has been reduced geographically. The subarea proposed peak discharge rates will be reduced below existing. The downstream enclosed sewer system was designed to convey the existing peak discharge rates.

8. EXHIBITS:

- **Exhibit A – Aerial Image**
- **Exhibit B – FEMA FIRMette**
- **Exhibit C – NRCS Soil Classification**
- **Exhibit D – Existing Drainage Area Map**
- **Exhibit E – Hydraflow Hydrograph Calculations (Pre, Post & Detention)**
- **Exhibit F – Proposed Drainage Area Map**
- **Exhibit G – Detention Basin Plan**
- **Exhibit H – Water Quality Volume Calculations**
- **Exhibit I – Emergency Spillway Calculations**